Storm Water Management Report

FOR

Deville 21 Lincoln Way

Out Lot 17416

City of Massillon

PREPARED FOR

21 Lincoln Way Projects, LLC
Suite 301
3951 Convenience Circle N.W.
Canton, OH 44718

PREPARED BY

GBC DESIGN, INC.
ARCHITECTURE AND ENGINEERING

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Job No.: 47190B **Date: 9/09/2015**

PROJECT DESCRIPTION AND SITE BACKGROUND

Currently the site consists of mainly grassy areas with a few existing tress along the east side of the property. The storm runoff currently drains via sheet flow across the site from northwest to southeast. Most of the site drains to the low point at the southeast corner of the property which then drains to an existing pump station on the adjacent property to the south. The project will consist of the construction of a (+/-) 4,996 S.F. building with associated paving, parking and site utilities. We have proposed a hydrodynamic separator for our post-construction water quality BMP. Per the EPA Post-Construction Q&A Document Question 14 this BMP is suitable for use on a small site. We have also proposed to provide the required detention within our storm sewer system. This is accomplished by oversizing some of the storm sewer runs so it will act as an underground detention system with an outlet structure to control the outflows per City of Massillon requirements, as detailed on the plans. The outflow from the outlet structure will be directed into the post-construction water quality BMP to be treated and then discharged into the pump station area.

RETENTION DESIGN CRITERIA

The City of Massillon is the governing agency for this project. Per their requirements, the post-developed peak flow rate for all storm frequencies must be less than or equal to the pre-developed peak flow rate for the storm of the same frequency.

WATER QUALITY DESIGN CRITERIA

We are proposing a Hydrodynamic Separator treatment system for our post-construction BMP. According to the Post-Construction Q&A Document dated March 20, 2007, the EPA finds this to be a suitable BMP for small construction sites. All storm water that gets into the storm inlets will be directed through the Hydrodynamic Separator via storm sewer before being discharged towards the pump station located at the northwest part of the site.

DRAINAGE AREA COMPOSITION

Existing Conditions Drainage Area

Existing Surface Conditions	Area, acres	Runoff C	Time of Concentration, min.
Open Space – Grass (Onsite)	0.76	0.30	38.0
Open Space – Grass (Offsite)	0.93	0.30	38.0
Total Area	1.69	0.30	38.0

Post-Developed Drainage Area

Post Surface Conditions	Area, acres	Runoff C	Time of Concentration, min.
Prop. Impervious Area	0.76	0.90	12.0
Open Space – Grass (Offsite)	0.93	0.30	12.0
Total Area	1.69	0.57	12.0

TIME OF CONCENTRATION

A time of concentration of 38 minutes was computed using the TR-55 method for the existing conditions. A post-developed time of concentration of 12.0 minutes was assumed based on the minimum 10 minute time of concentration, Tc, for pavement catch basins and 15 minute time of concentration, Tc, for the ditch catch basins in accordance with section 1104.44 of the O.D.O.T. Drainage Design Manual. These calculations can be found within this report.

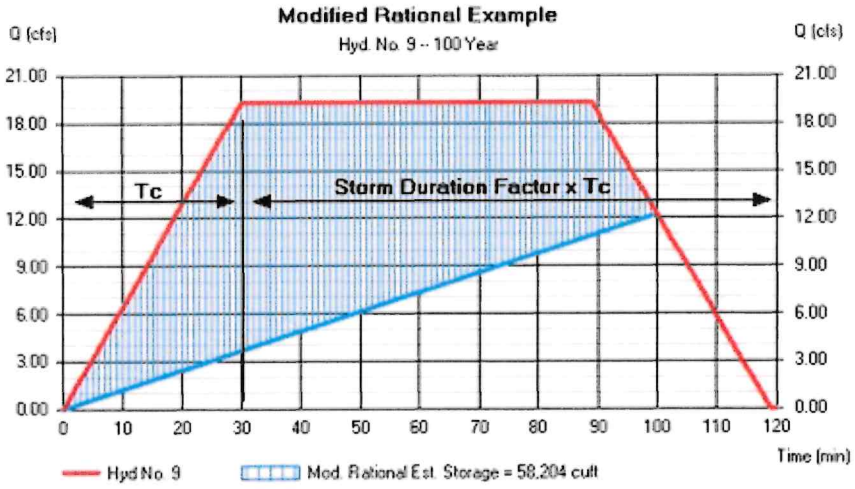
STORM SEWER CALCULATIONS

Hydraflow Storm Sewers 2015 was used to perform all the storm sewer computations, calculations follow.

The storm sewer has been designed to meet full flow capacity for a 10 year storm with a manning's n-value of 0.015 and using the IDF values based on zone A from ODOT Drainage & Design Manual.

PROP. STORM WATER MGMT./WATER QUALITY BASIN ROUTING PROCEDURE

Hydraflow Hydragrpahs Extenstion 2015 by AutoDesk was used to perform the storm routing and the pond calculations. The modified rational method was used to generate the peak flows for each storm event. This method takes the Standard Rational to a different level in order to yield a hydrograph for use in detention pond design. According to the rational method, the highest Qp occurs when the rainfall duration equals Tc. When the rainfall duration is greater than Tc, the Qp is reduced, but the total runoff volume is increased. This greater volume can increase the required size of a detention pond.



Hydraflow simply modifies the Storm Duration Factor between successive storage estimates to arrive at the critical event or Storm Duration Factor. The design information used for the analysis along with the routing results follow.

ALLOWABLE OUTFLOW SUMMARY

The allowable outflow from the site will be determined as follows. For all storm events the post-developed outflow rate cannot exceed the pre-developed outflow rate of the same frequency storm. The IDF values used for routing the storms are based on zone A from ODOT Drainage & Design Manual.

STORM ROUTING AND POND DESIGN SUMMARY

The following table summarizes the peak outflow from the underground detention system.

Storm Event, Year	Allowable Outflow (Existing Conditions) Rate from Site, c.f.s.	Peak Outflow Rate from Pond, c.f.s.	Peak W.S. Elevation in Pond	Peak Storage in Pond, c.f.
2	0.84	0.84	927.28	1,741
5	1.05	0.95	927.84	2,558
10	1.21	1.04	928.17	3,039
25	1.48	1.40	928.76	3,832
50	1.58	1.51	929.04	4,157
100	1.79	1.78	929.90	4,744

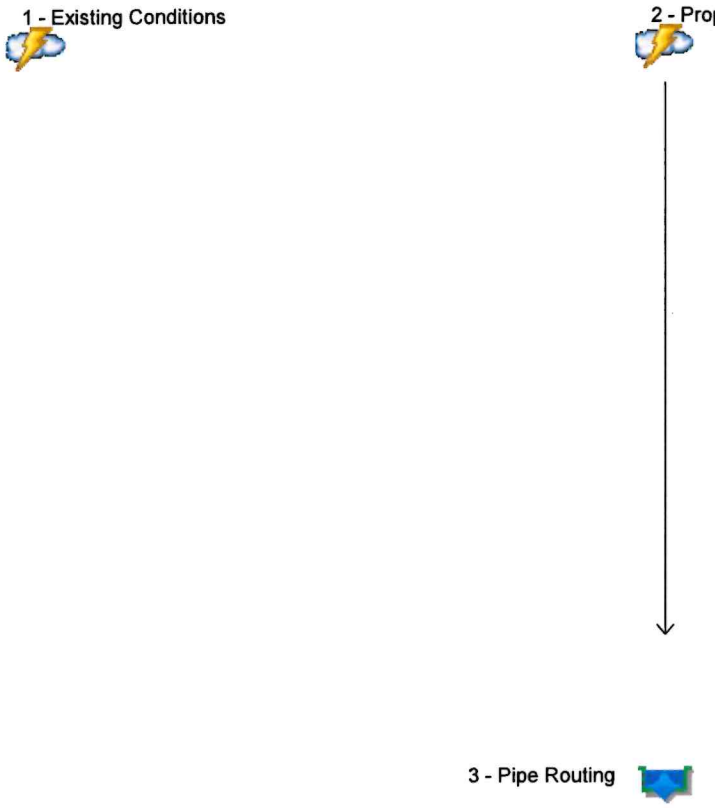
The following table summarizes the detention pond outlet structure details.

Top of Detention Chamber	930.74
Top of Structure	932.15
Inv. of 4" Orifice	928.04
Invert of 4.75" Orifice	924.79
Invert of 12" Discharge Pipe	924.79

WATERSHED MODEL SCHEMATIC

Watershed Model Schematic

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4



POND REPORT

Pond Report

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Pond No. 1 - Oversized Pipe Storage

Pond Data

UG Chambers -Invert elev. = 924.79 ft, Rise x Span = 4.00 x 4.00 ft, Barrel Len = 390.00 ft, No. Barrels = 1, Slope = 0.50%, Headers = No

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	924.79	n/a	0	0
0.60	925.38	n/a	76	76
1.19	925.98	n/a	196	272
1.78	926.58	n/a	555	827
2.38	927.17	n/a	752	1,579
2.97	927.77	n/a	873	2,452
3.57	928.36	n/a	872	3,324
4.16	928.96	n/a	752	4,076
4.76	929.55	n/a	554	4,630
5.36	930.15	n/a	196	4,826
5.95	930.74	n/a	76	4,902

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	4.75	4.00	0.00
Span (in)	= 12.00	4.75	4.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 924.79	924.79	928.04	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 2.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	Yes	No

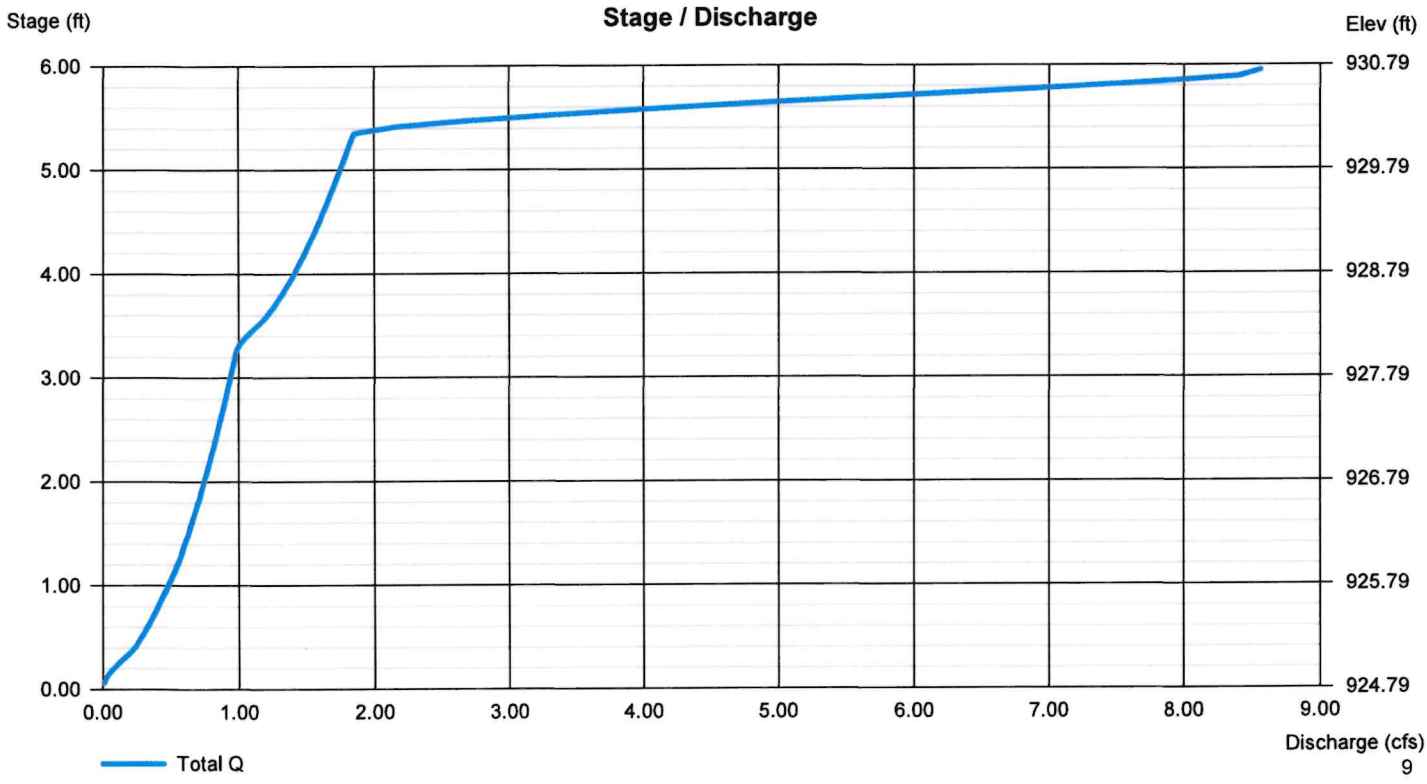
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 8.00	6.00	0.00	0.00
Crest El. (ft)	= 932.15	930.14	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	Ciplti	---	---
Multi-Stage	= Yes	Yes	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



TIME OF CONCENTRATION, Tc

TR55 Tc Worksheet

Hyd. No. 1

Existing Conditions

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 2.43		0.00		0.00		
Land slope (%)	= 1.10		0.00		0.00		
Travel Time (min)	**= 34.39**	**+**	**0.00**	**+**	**0.00**	**=**	**34.39**
Shallow Concentrated Flow							
Flow length (ft)	= 238.00		0.00		0.00		
Watercourse slope (%)	= 0.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.14		0.00		0.00		
Travel Time (min)	**= 3.48**	**+**	**0.00**	**+**	**0.00**	**=**	**3.48**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... **37.87 min**

HYDROGRAPH RETURN PERIOD RECAP

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	-------	0.842	-------	1.055	1.211	1.477	1.577	1.792	Existing Conditions
2	Mod. Rational	------	-------	1.374	-------	1.997	1.975	2.405	2.520	2.925	Proposed Conditions
3	Reservoir	2	-------	0.843	-------	0.946	1.039	1.397	1.506	1.779	Pipe Routing

2 YEAR HYDROGRAPH REPORTS

Hydrograph Report

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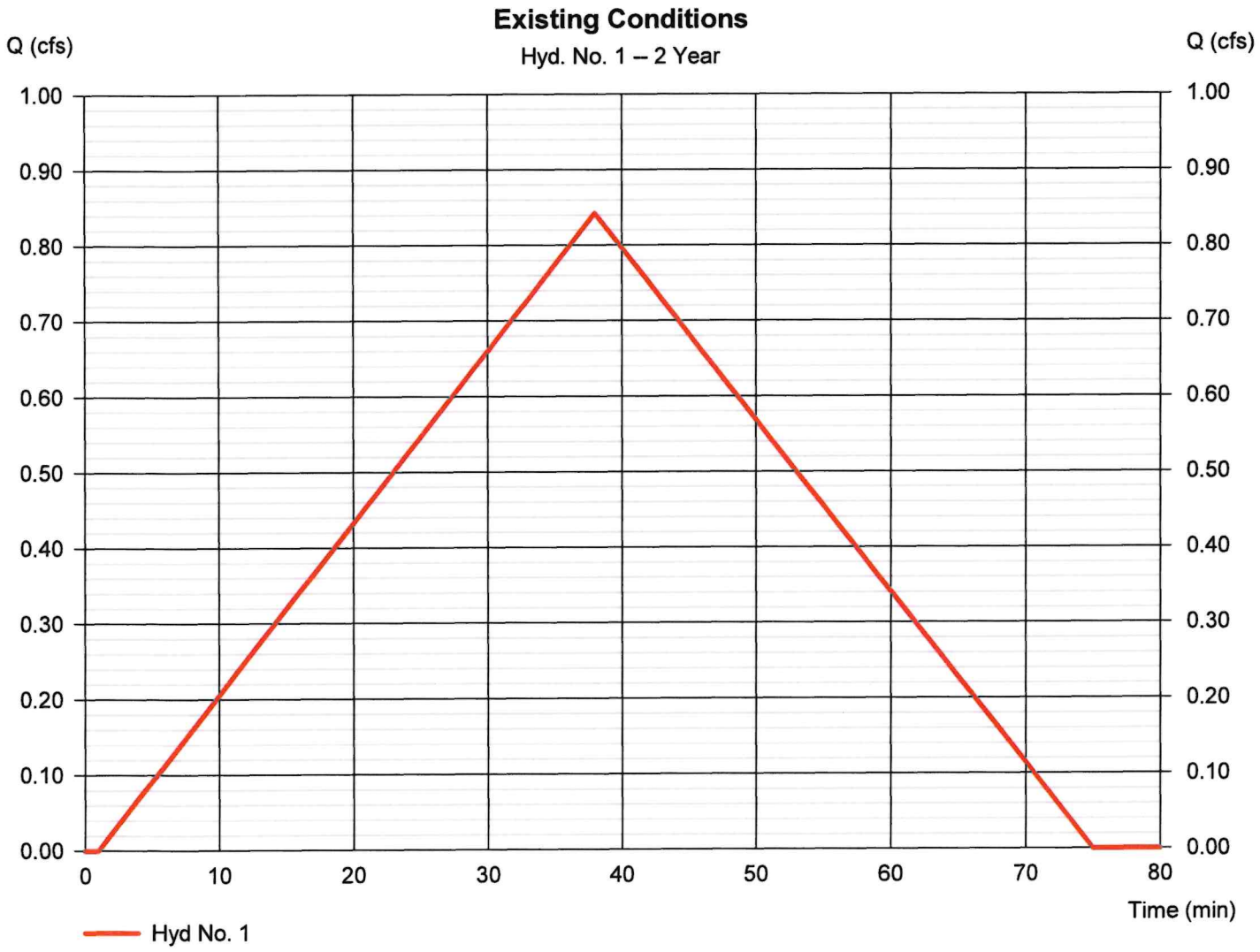
Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 0.842 cfs
Storm frequency	= 2 yrs	Time to peak	= 38 min
Time interval	= 1 min	Hyd. volume	= 1,914 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.3
Intensity	= 1.661 in/hr	Tc by TR55	= 37.87 min
IDF Curve	= ODOT AREA A.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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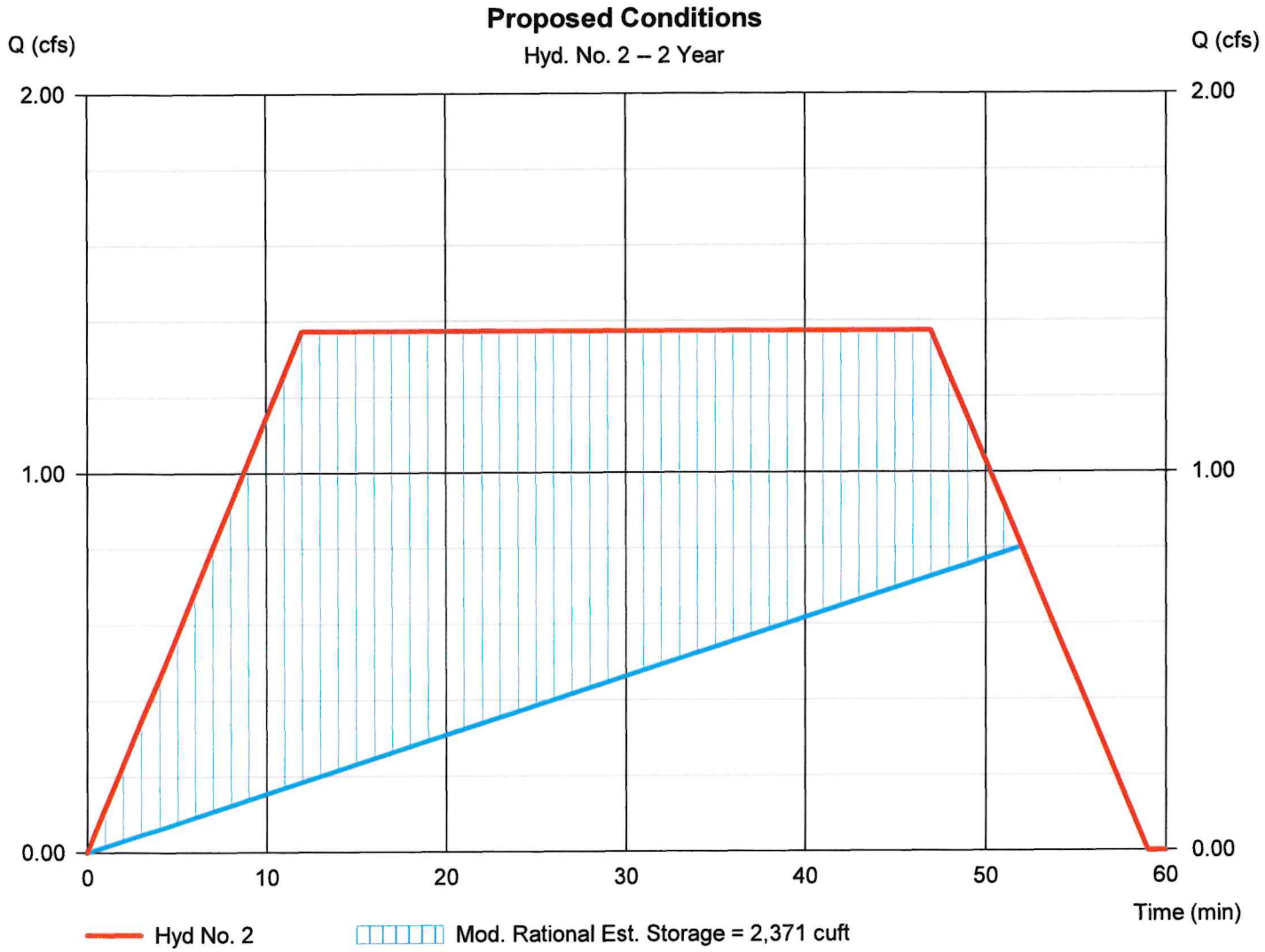
Hyd. No. 2

Proposed Conditions

Hydrograph type	= Mod. Rational	Peak discharge	= 1.374 cfs
Storm frequency	= 2 yrs	Time to peak	= 12 min
Time interval	= 1 min	Hyd. volume	= 3,877 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.57*
Intensity	= 1.426 in/hr	Tc by User	= 12.00 min
IDF Curve	= ODOT AREA A.IDF	Storm duration	= 3.9 x Tc
Target Q	=0.840 cfs	Est. Req'd Storage	=2,371 cuft

* Composite (Area/C) = [(0.760 x 0.90) + (0.930 x 0.30)] / 1.690



Hydrograph Report

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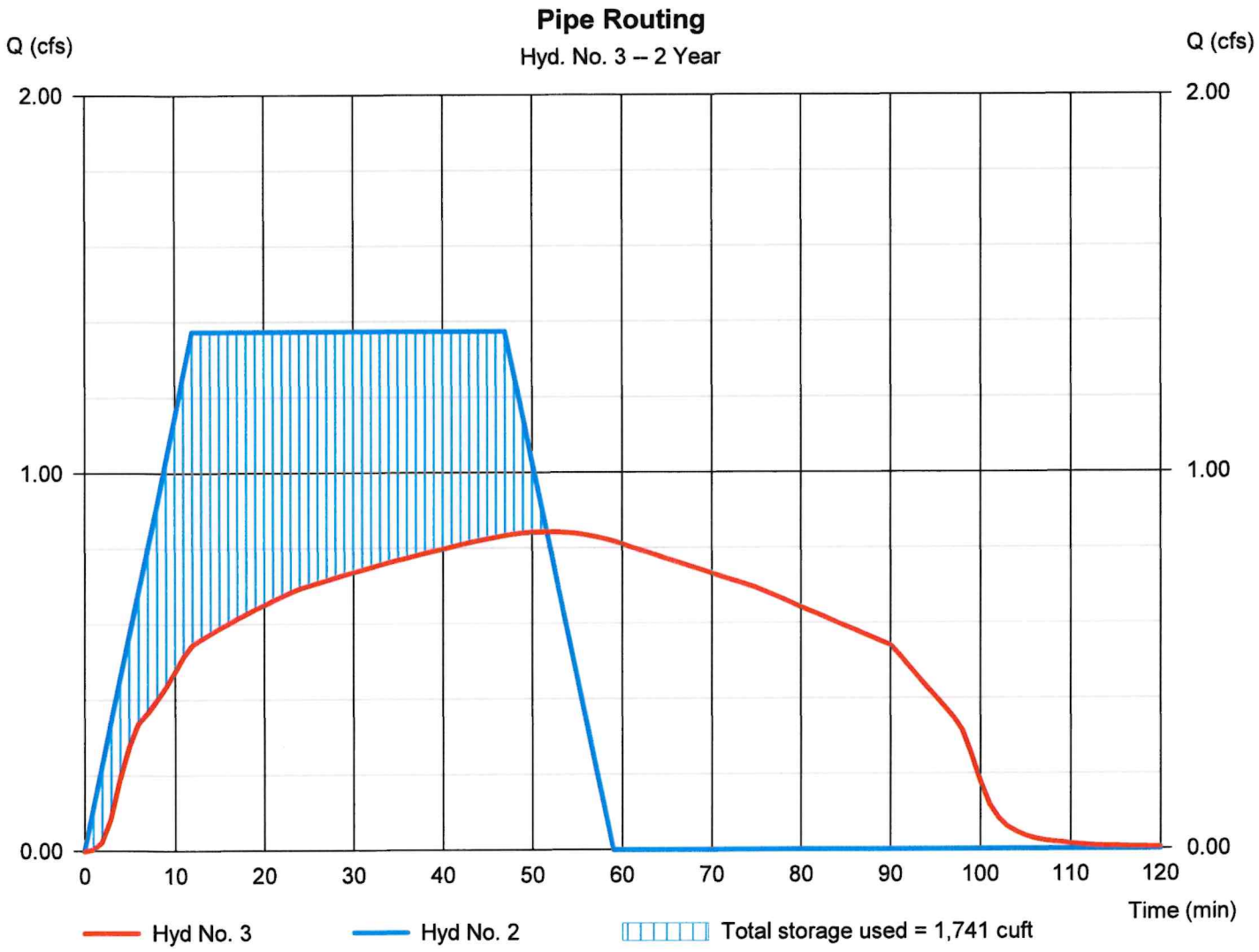
Hyd. No. 3

Pipe Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.843 cfs
Storm frequency	= 2 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 3,873 cuft
Inflow hyd. No.	= 2 - Proposed Conditions	Max. Elevation	= 927.28 ft
Reservoir name	= Oversized Pipe Storage	Max. Storage	= 1,741 cuft

Storage Indication method used.



Hydrograph Summary Report

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Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	0.842	1	38	1,914	------	------	------	Existing Conditions
2	Mod. Rational	1.374	1	12	3,877	------	------	------	Proposed Conditions
3	Reservoir	0.843	1	52	3,873	2	927.28	1,741	Pipe Routing

5 YEAR HYDROGRAPH REPORTS

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.055	1	38	2,396	------	------	------	Existing Conditions
2	Mod. Rational	1.997	1	12	4,559	------	------	------	Proposed Conditions
3	Reservoir	0.946	1	44	4,553	2	927.84	2,558	Pipe Routing

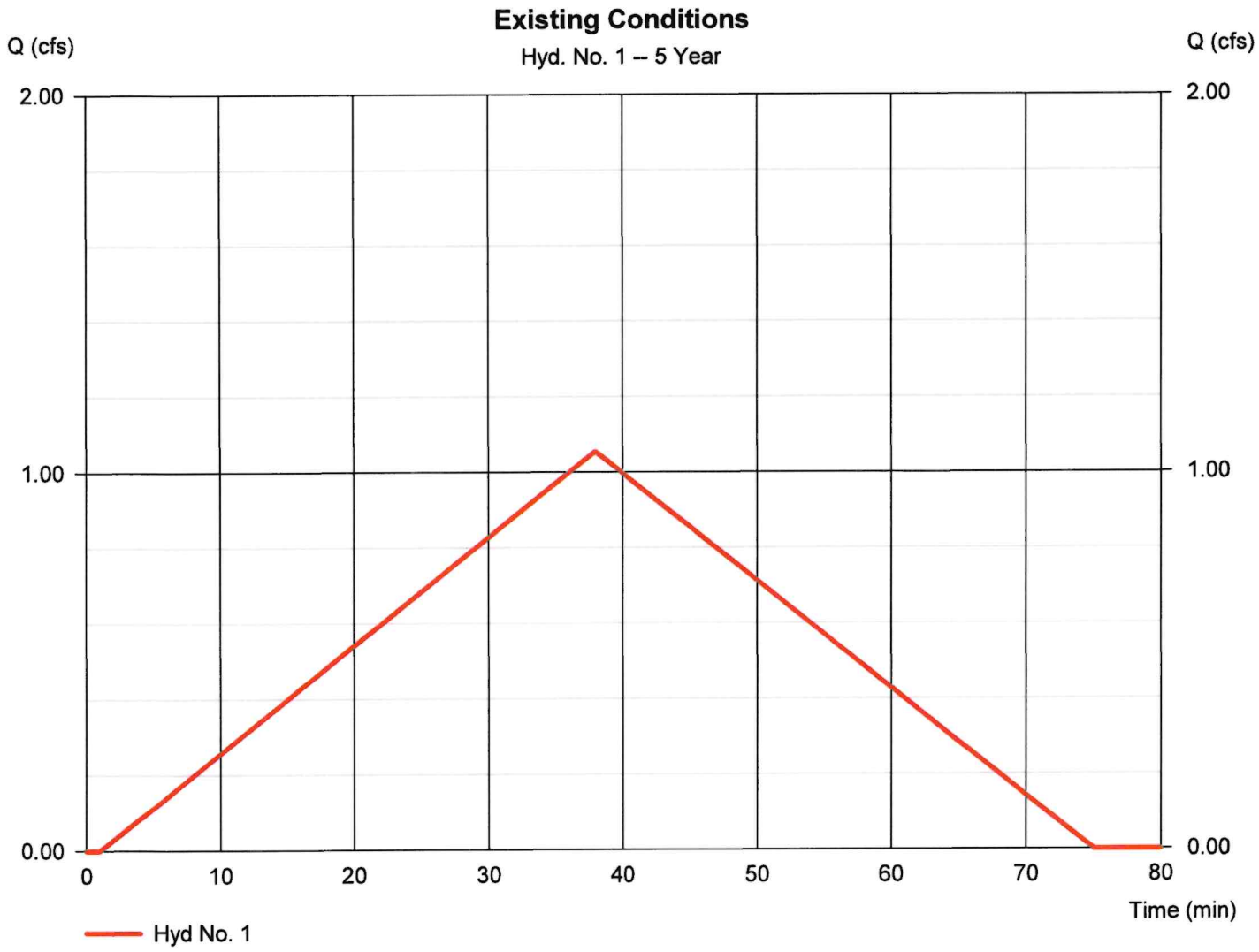
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 — Wednesday, 09 / 9 / 2015

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 1.055 cfs
Storm frequency	= 5 yrs	Time to peak	= 38 min
Time interval	= 1 min	Hyd. volume	= 2,396 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.3
Intensity	= 2.080 in/hr	Tc by TR55	= 37.87 min
IDF Curve	= ODOT AREA A.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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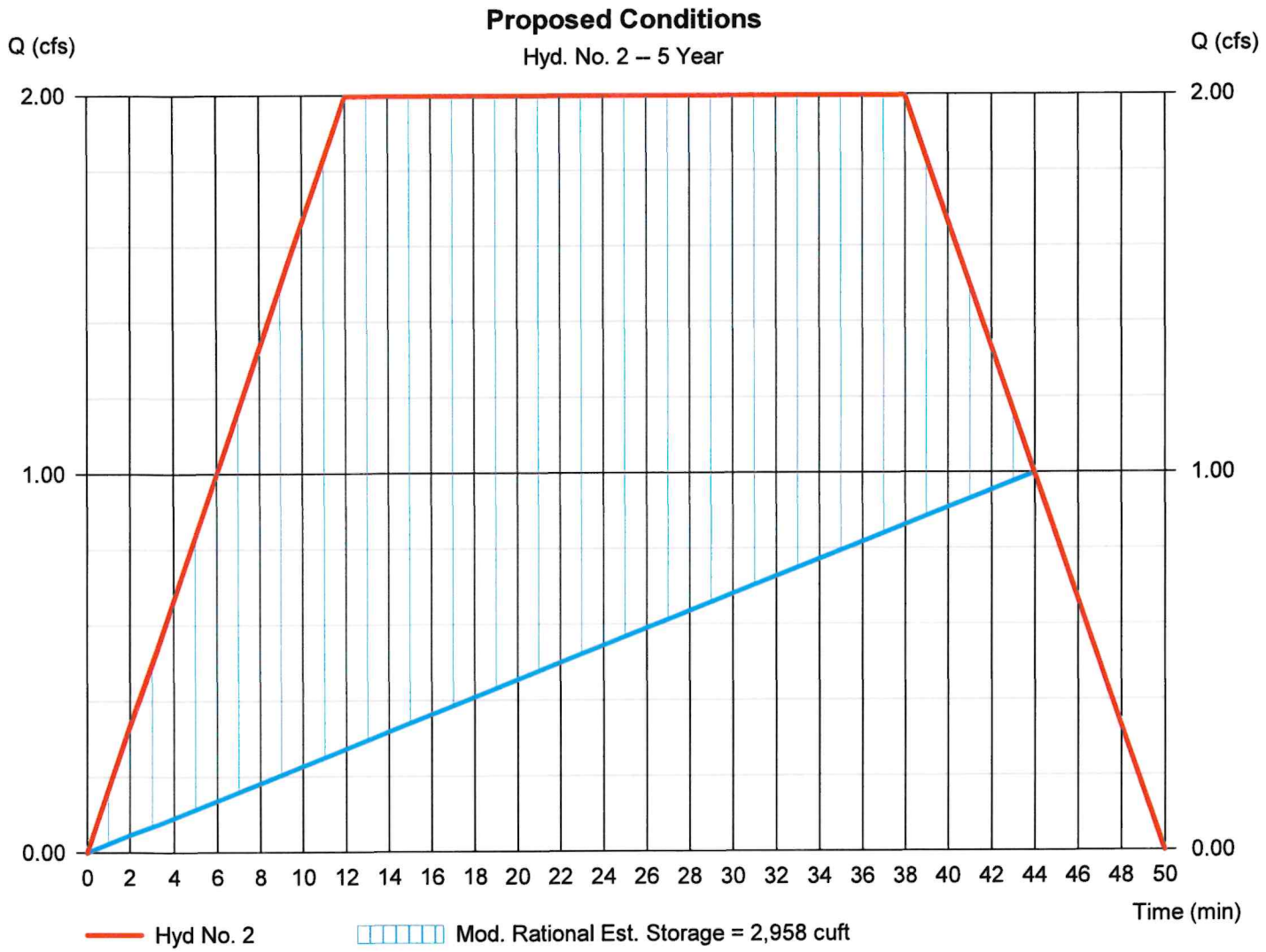
Hyd. No. 2

Proposed Conditions

Hydrograph type	= Mod. Rational	Peak discharge	= 1.997 cfs
Storm frequency	= 5 yrs	Time to peak	= 12 min
Time interval	= 1 min	Hyd. volume	= 4,559 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.57*
Intensity	= 2.073 in/hr	Tc by User	= 12.00 min
IDF Curve	= ODOT AREA A.IDF	Storm duration	= 3.2 x Tc
Target Q	=1.050 cfs	Est. Req'd Storage	=2,958 cuft

* Composite (Area/C) = [(0.760 x 0.90) + (0.930 x 0.30)] / 1.690



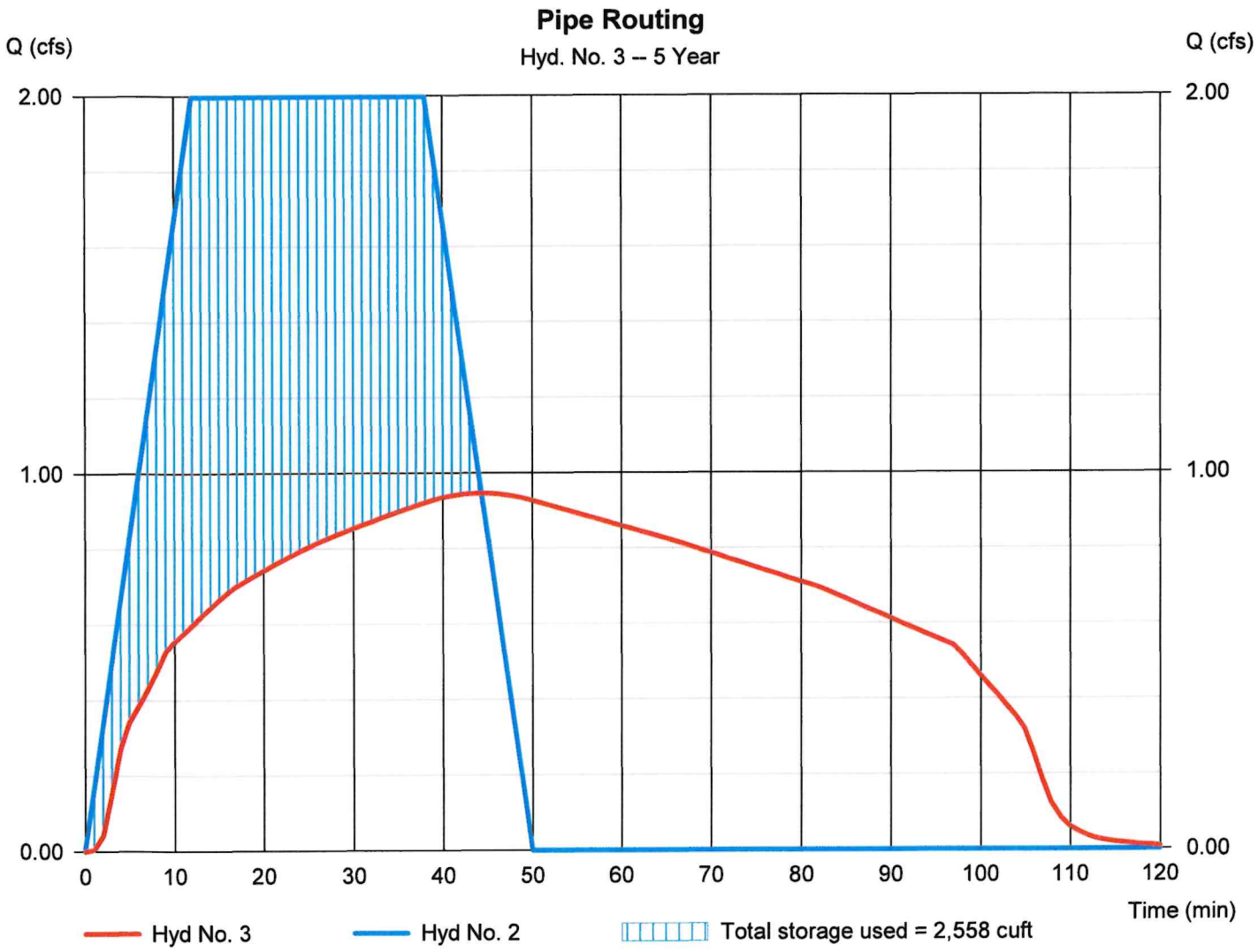
Hydrograph Report

Hyd. No. 3

Pipe Routing

Hydrograph type	= Reservoir	Peak discharge	= 0.946 cfs
Storm frequency	= 5 yrs	Time to peak	= 44 min
Time interval	= 1 min	Hyd. volume	= 4,553 cuft
Inflow hyd. No.	= 2 - Proposed Conditions	Max. Elevation	= 927.84 ft
Reservoir name	= Oversized Pipe Storage	Max. Storage	= 2,558 cuft

Storage Indication method used.



10 YEAR HYDROGRAPH REPORTS

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.211	1	38	2,751	------	------	------	Existing Conditions
2	Mod. Rational	1.975	1	12	5,574	------	------	------	Proposed Conditions
3	Reservoir	1.039	1	53	5,568	2	928.17	3,039	Pipe Routing

Hydrograph Report

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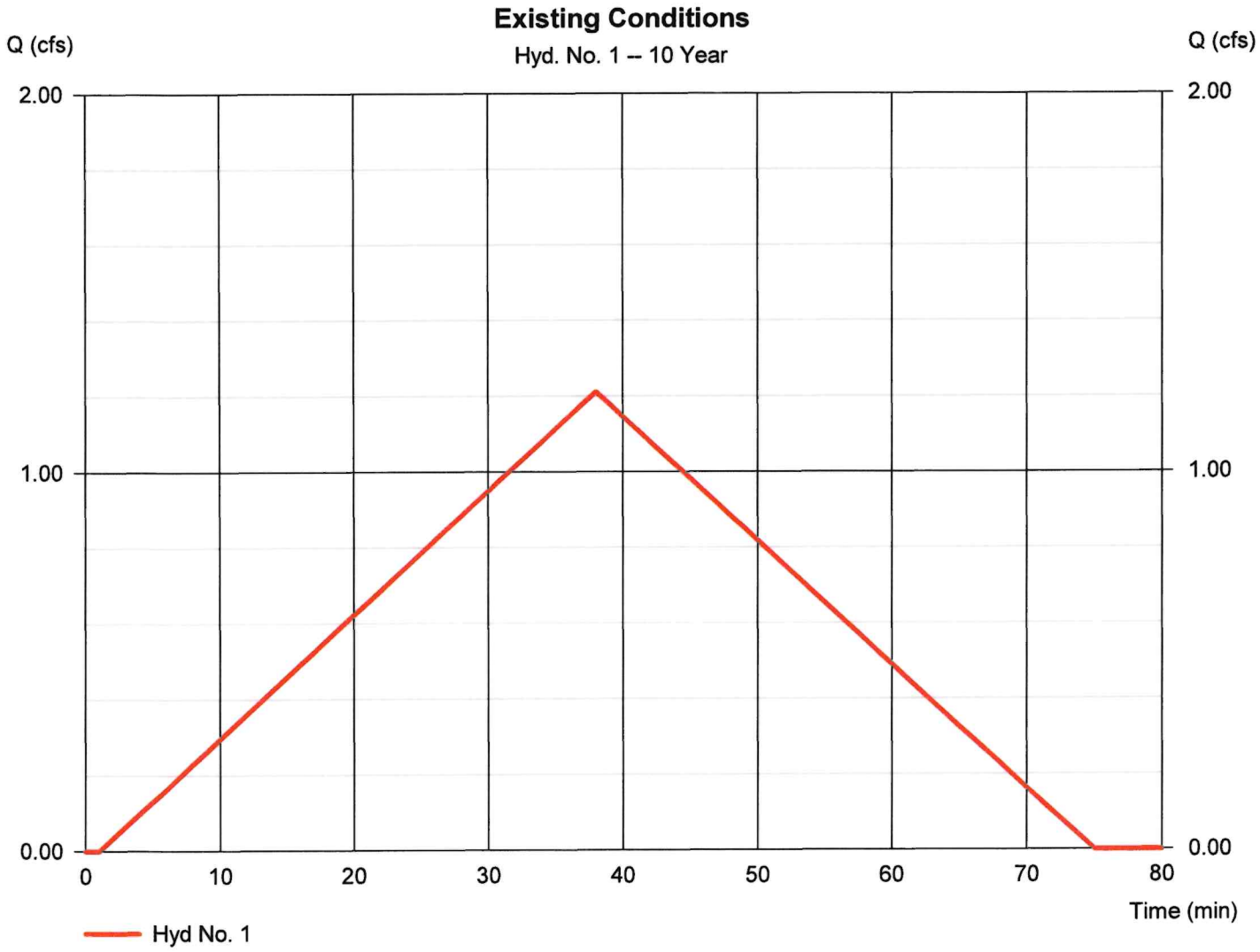
Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 1.211 cfs
Storm frequency	= 10 yrs	Time to peak	= 38 min
Time interval	= 1 min	Hyd. volume	= 2,751 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.3
Intensity	= 2.388 in/hr	Tc by TR55	= 37.87 min
IDF Curve	= ODOT AREA A.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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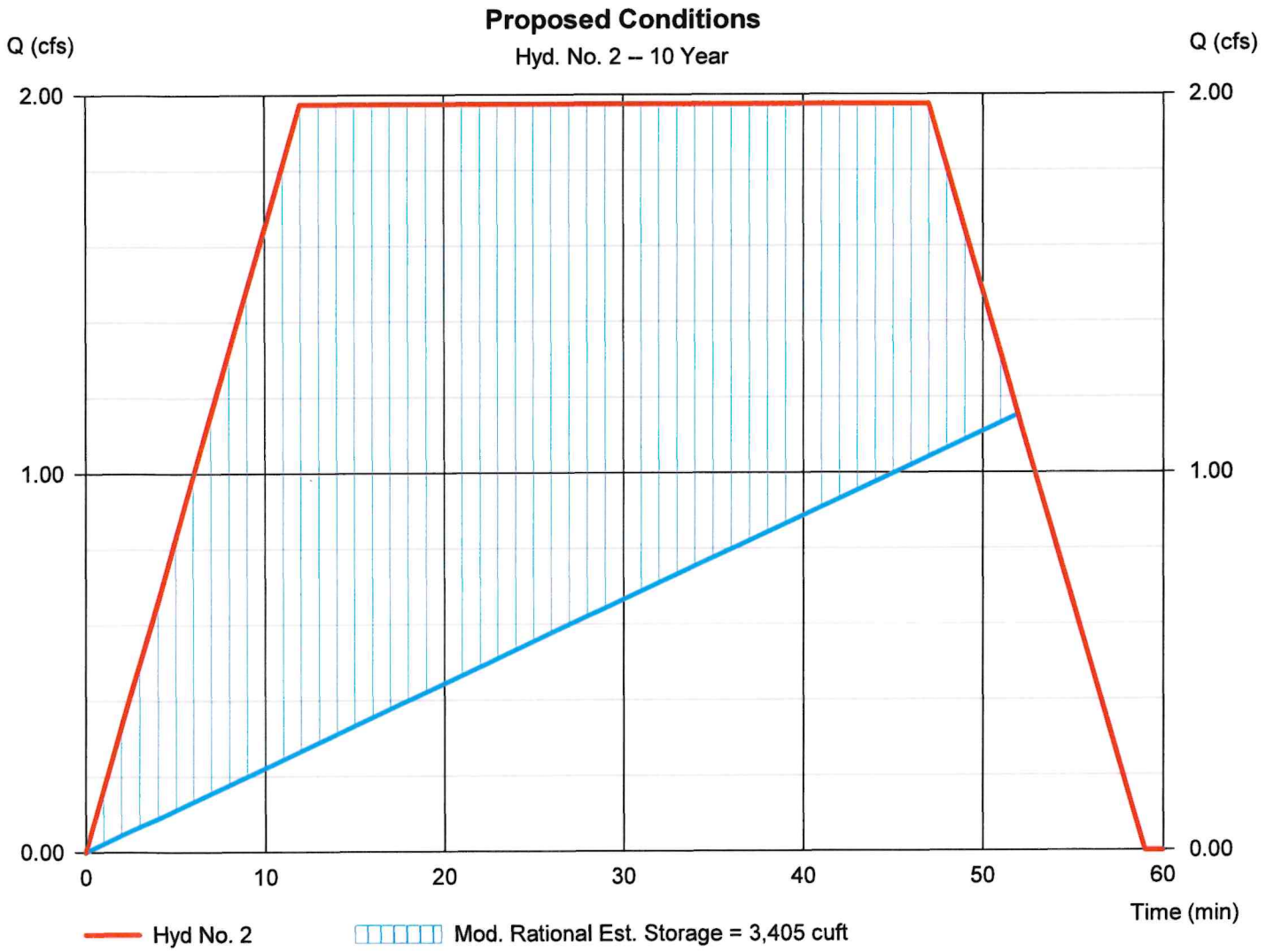
Hyd. No. 2

Proposed Conditions

Hydrograph type	= Mod. Rational	Peak discharge	= 1.975 cfs
Storm frequency	= 10 yrs	Time to peak	= 12 min
Time interval	= 1 min	Hyd. volume	= 5,574 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.57*
Intensity	= 2.050 in/hr	Tc by User	= 12.00 min
IDF Curve	= ODOT AREA A.IDF	Storm duration	= 3.9 x Tc
Target Q	=1.210 cfs	Est. Req'd Storage	=3,405 cuft

* Composite (Area/C) = [(0.760 x 0.90) + (0.930 x 0.30)] / 1.690



Hydrograph Report

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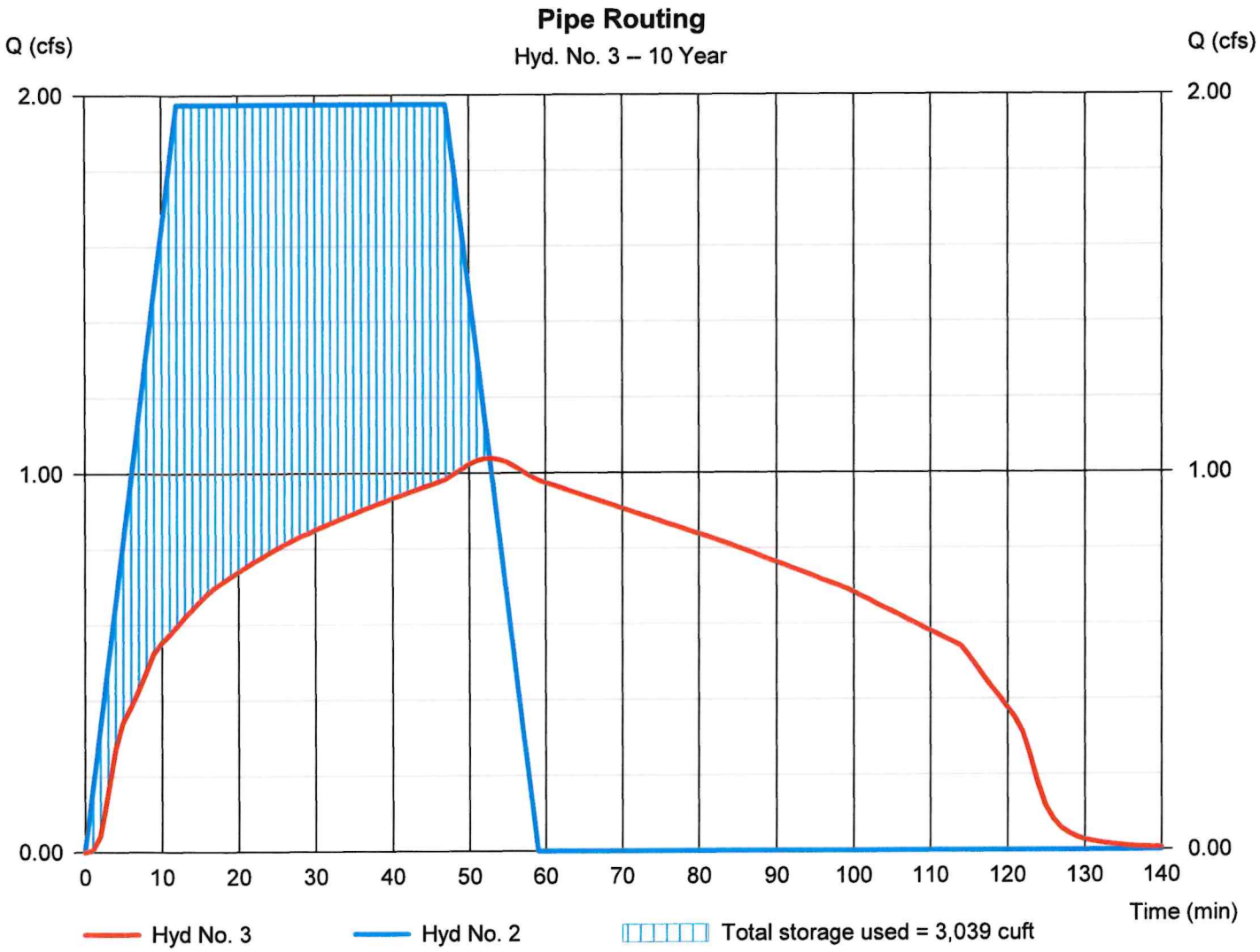
Hyd. No. 3

Pipe Routing

Hydrograph type	= Reservoir	Peak discharge	= 1.039 cfs
Storm frequency	= 10 yrs	Time to peak	= 53 min
Time interval	= 1 min	Hyd. volume	= 5,568 cuft
Inflow hyd. No.	= 2 - Proposed Conditions	Max. Elevation	= 928.17 ft
Reservoir name	= Oversized Pipe Storage	Max. Storage	= 3,039 cuft

Storage Indication method used.



25 YEAR HYDROGRAPH REPORTS

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.477	1	38	3,355	------	------	------	Existing Conditions
2	Mod. Rational	2.405	1	12	6,787	------	------	------	Proposed Conditions
3	Reservoir	1.397	1	52	6,780	2	928.76	3,832	Pipe Routing

Hydrograph Report

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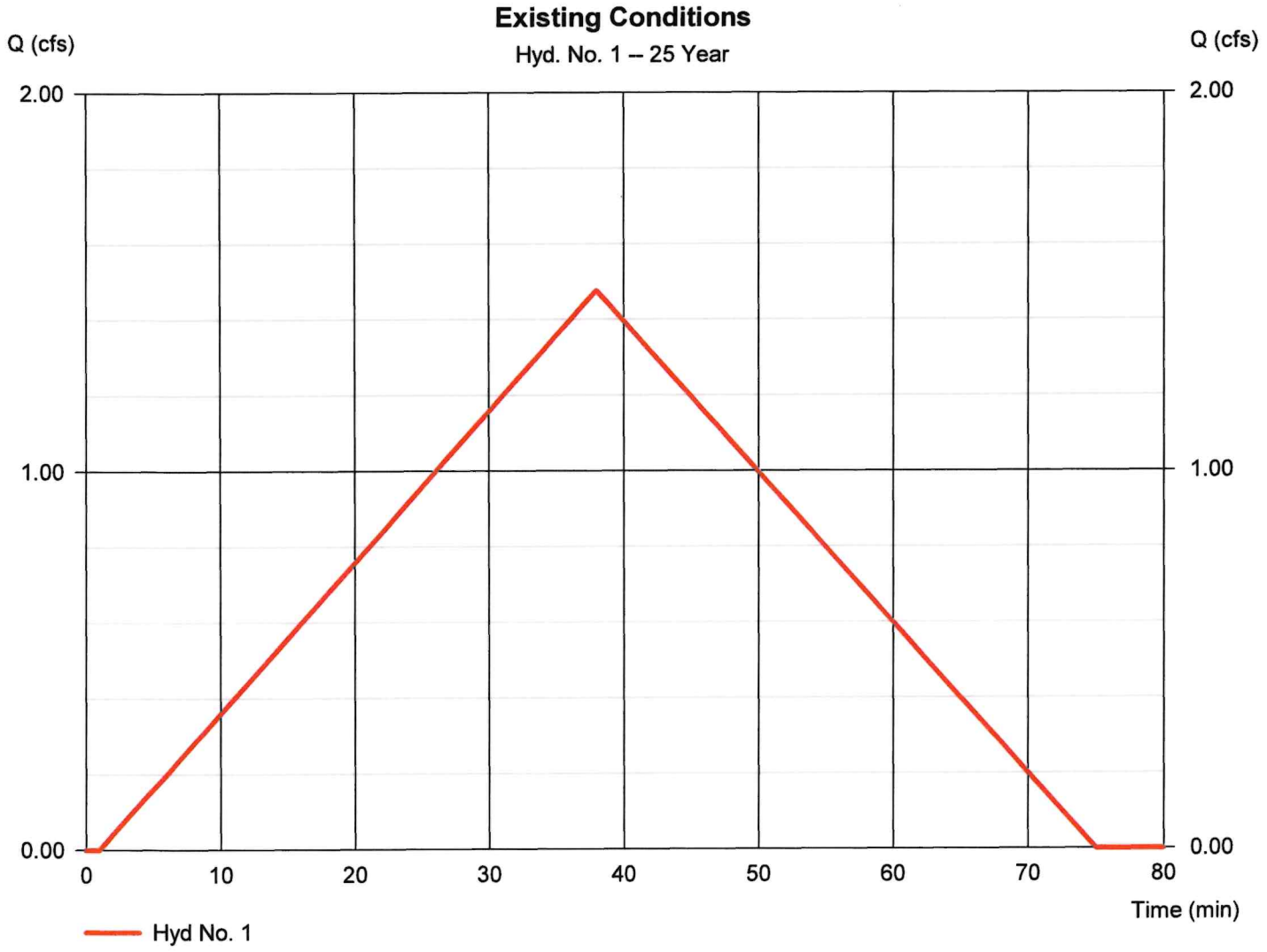
Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 1.477 cfs
Storm frequency	= 25 yrs	Time to peak	= 38 min
Time interval	= 1 min	Hyd. volume	= 3,355 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.3
Intensity	= 2.913 in/hr	Tc by TR55	= 37.87 min
IDF Curve	= ODOT AREA A.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

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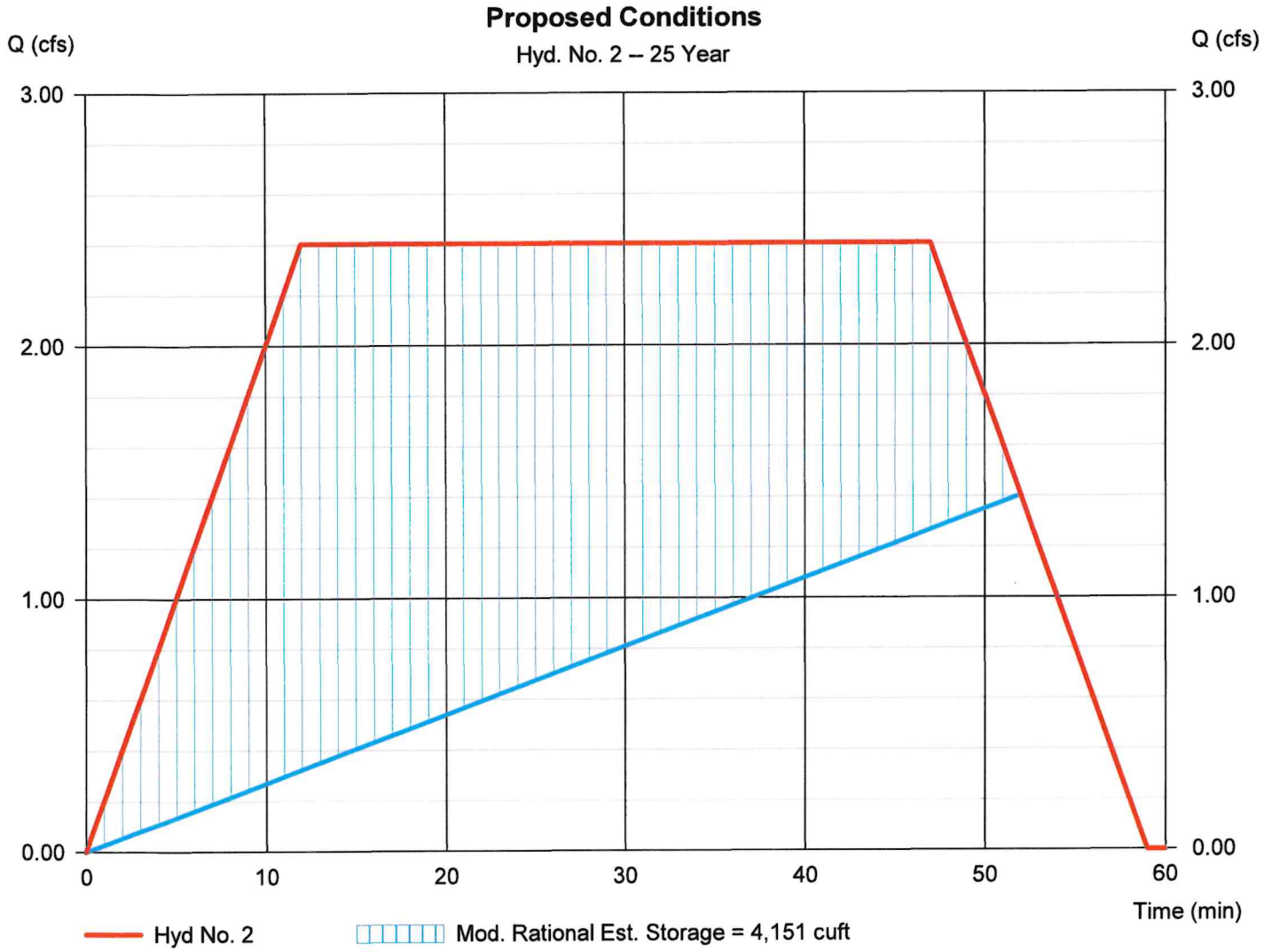
Hyd. No. 2

Proposed Conditions

Hydrograph type	= Mod. Rational	Peak discharge	= 2.405 cfs
Storm frequency	= 25 yrs	Time to peak	= 12 min
Time interval	= 1 min	Hyd. volume	= 6,787 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.57*
Intensity	= 2.496 in/hr	Tc by User	= 12.00 min
IDF Curve	= ODOT AREA A.IDF	Storm duration	= 3.9 x Tc
Target Q	=1.470 cfs	Est. Req'd Storage	=4,151 cuft

* Composite (Area/C) = [(0.760 x 0.90) + (0.930 x 0.30)] / 1.690



Hydrograph Report

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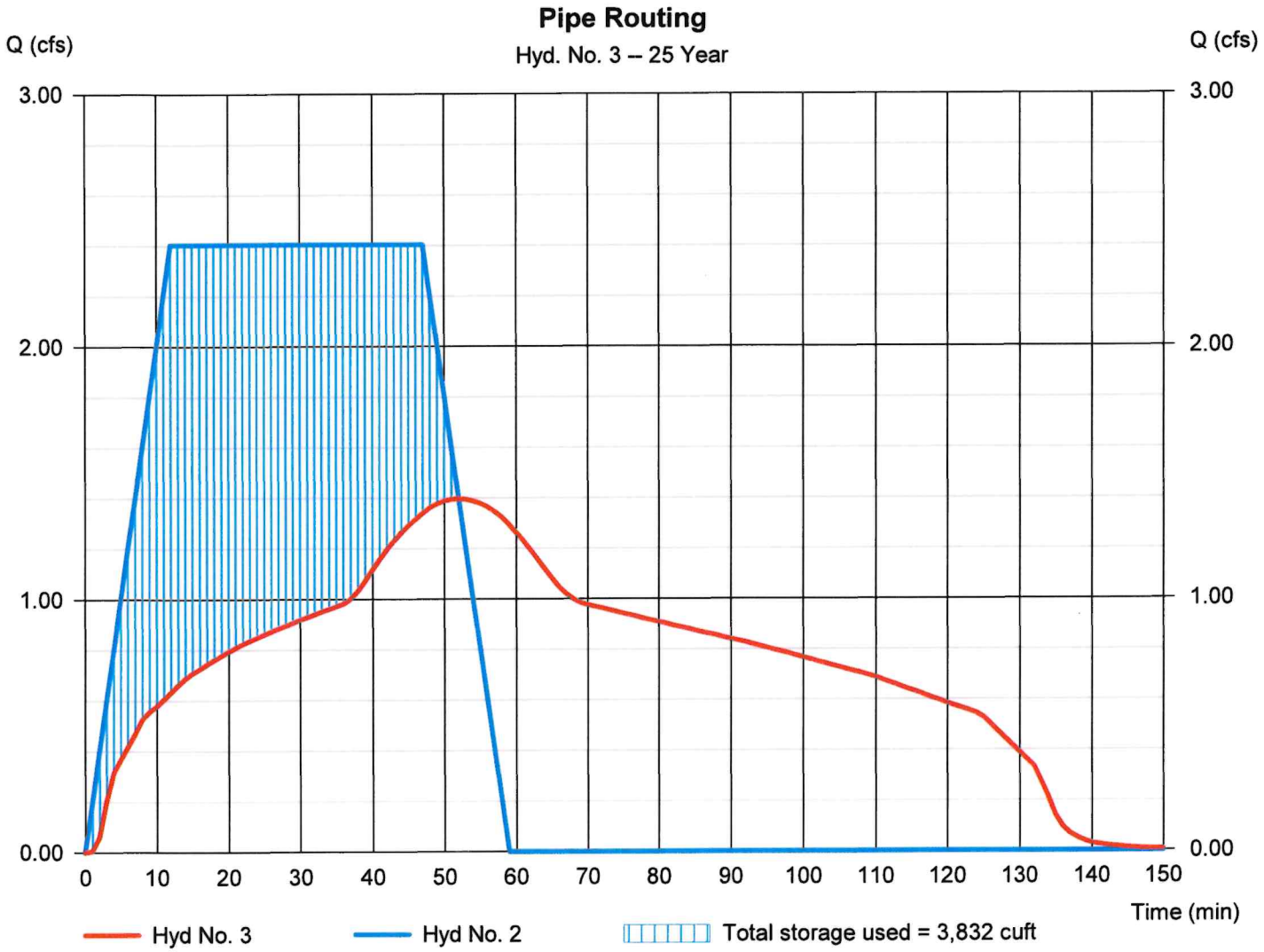
Hyd. No. 3

Pipe Routing

Hydrograph type	= Reservoir	Peak discharge	= 1.397 cfs
Storm frequency	= 25 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 6,780 cuft
Inflow hyd. No.	= 2 - Proposed Conditions	Max. Elevation	= 928.76 ft
Reservoir name	= Oversized Pipe Storage	Max. Storage	= 3,832 cuft

Storage Indication method used.



50 YEAR HYDROGRAPH REPORTS

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.577	1	38	3,584	------	------	------	Existing Conditions
2	Mod. Rational	2.520	1	12	7,421	------	------	------	Proposed Conditions
3	Reservoir	1.506	1	54	7,408	2	929.04	4,157	Pipe Routing

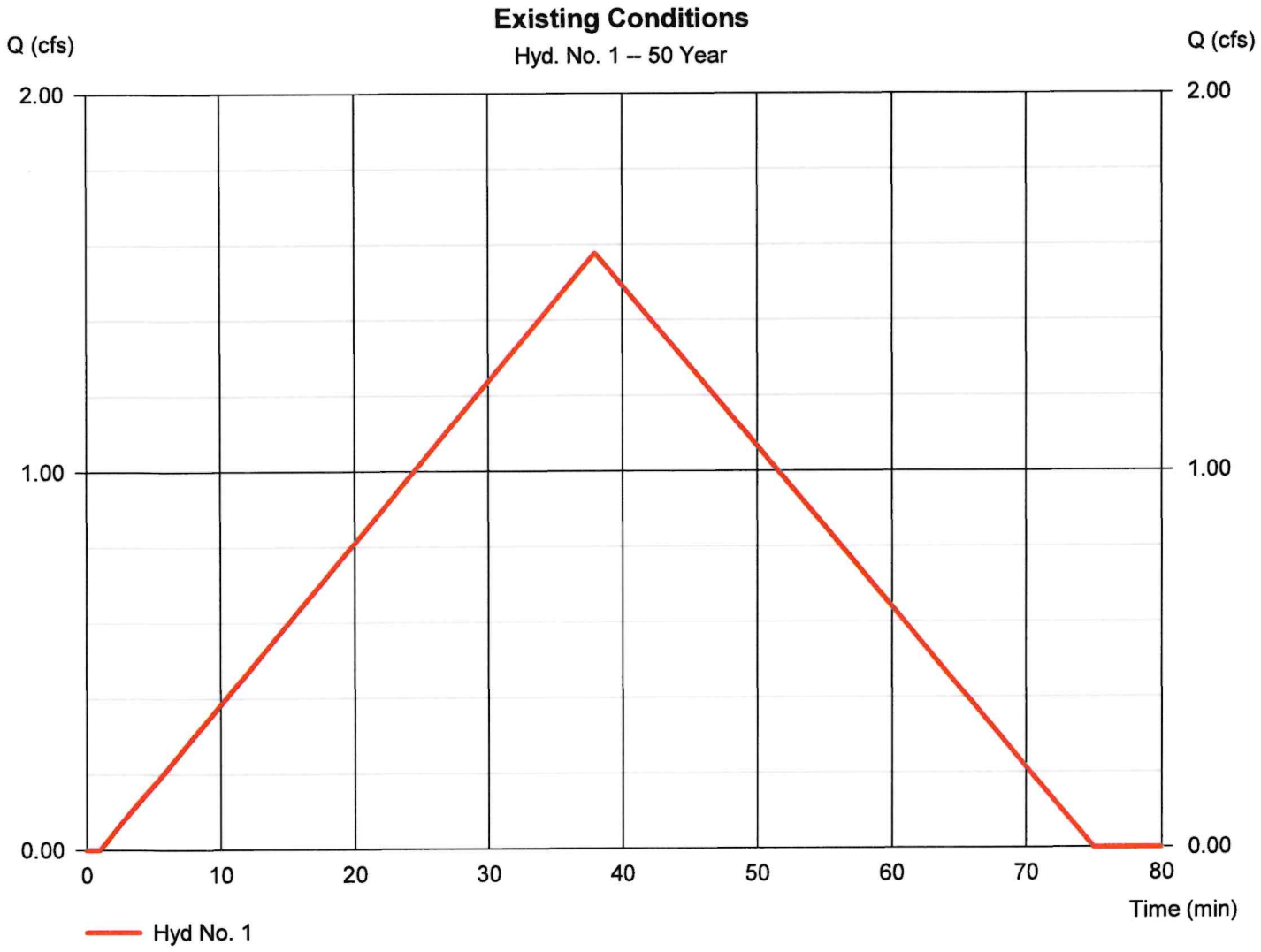
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 — Wednesday, 09 / 9 / 2015

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 1.577 cfs
Storm frequency	= 50 yrs	Time to peak	= 38 min
Time interval	= 1 min	Hyd. volume	= 3,584 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.3
Intensity	= 3.111 in/hr	Tc by TR55	= 37.87 min
IDF Curve	= ODOT AREA A.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

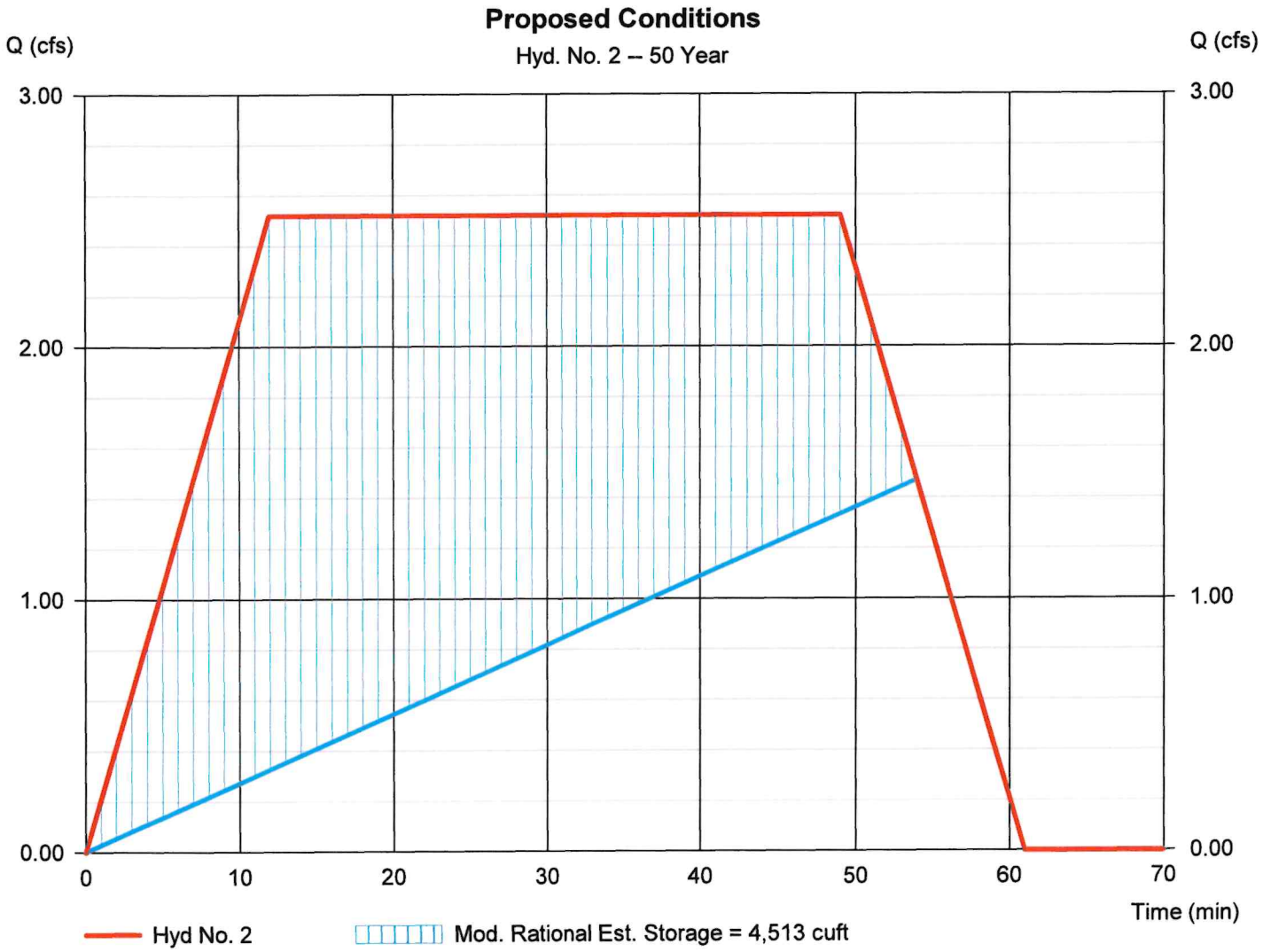
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 — Wednesday, 09 / 9 / 2015

Hyd. No. 2

Proposed Conditions

Hydrograph type	= Mod. Rational	Peak discharge	= 2.520 cfs
Storm frequency	= 50 yrs	Time to peak	= 12 min
Time interval	= 1 min	Hyd. volume	= 7,421 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.57*
Intensity	= 2.616 in/hr	Tc by User	= 12.00 min
IDF Curve	= ODOT AREA A.IDF	Storm duration	= 4.1 x Tc
Target Q	=1.570 cfs	Est. Req'd Storage	=4,513 cuft

* Composite (Area/C) = [(0.760 x 0.90) + (0.930 x 0.30)] / 1.690



Hydrograph Report

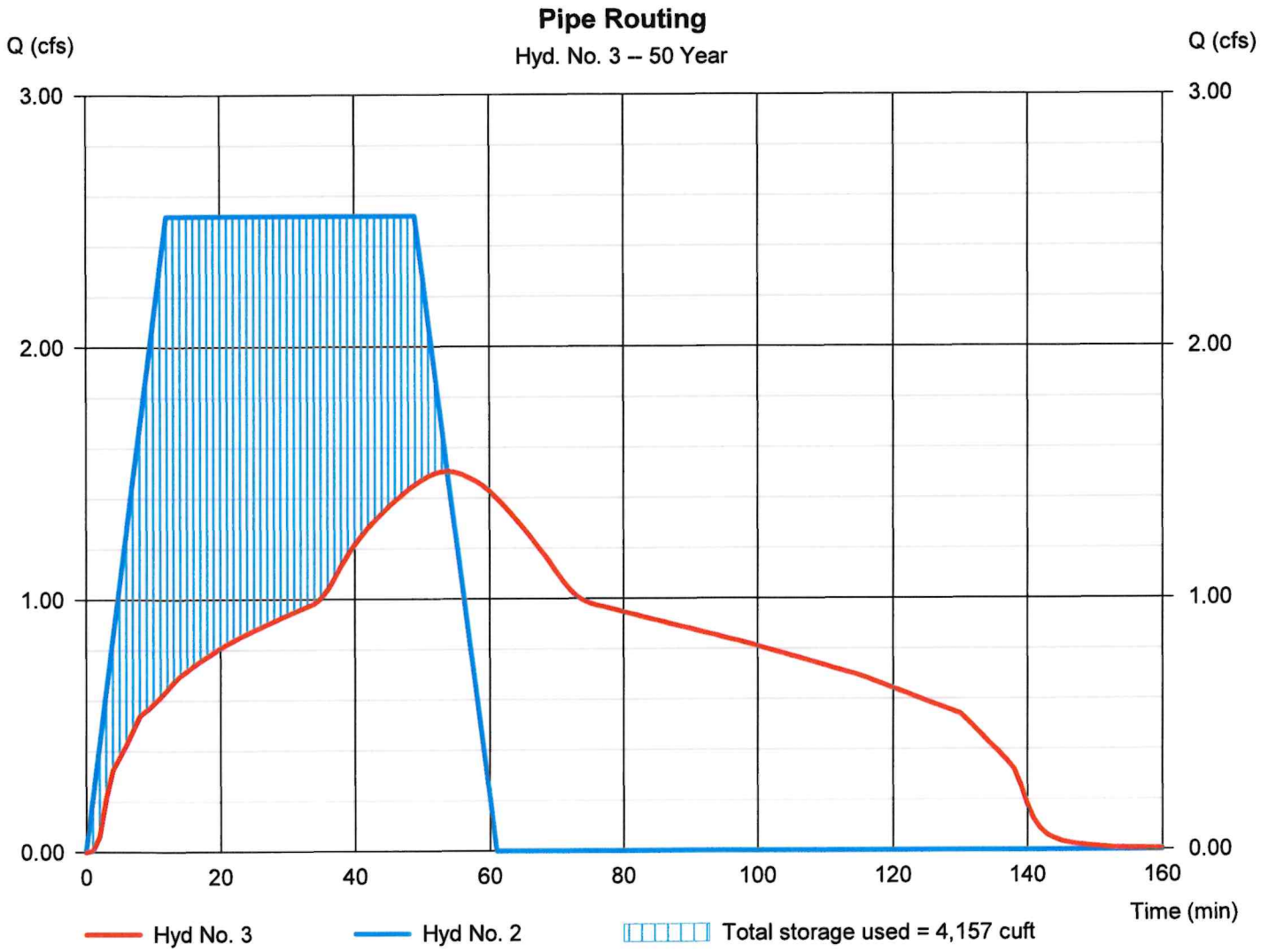
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 — Wednesday, 09 / 9 / 2015

Hyd. No. 3

Pipe Routing

Hydrograph type	= Reservoir	Peak discharge	= 1.506 cfs
Storm frequency	= 50 yrs	Time to peak	= 54 min
Time interval	= 1 min	Hyd. volume	= 7,408 cuft
Inflow hyd. No.	= 2 - Proposed Conditions	Max. Elevation	= 929.04 ft
Reservoir name	= Oversized Pipe Storage	Max. Storage	= 4,157 cuft

Storage Indication method used.



100 YEAR HYDROGRAPH REPORTS

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.792	1	38	4,073	------	------	------	Existing Conditions
2	Mod. Rational	2.925	1	12	8,257	------	------	------	Proposed Conditions
3	Reservoir	1.779	1	52	8,249	2	929.90	4,744	Pipe Routing

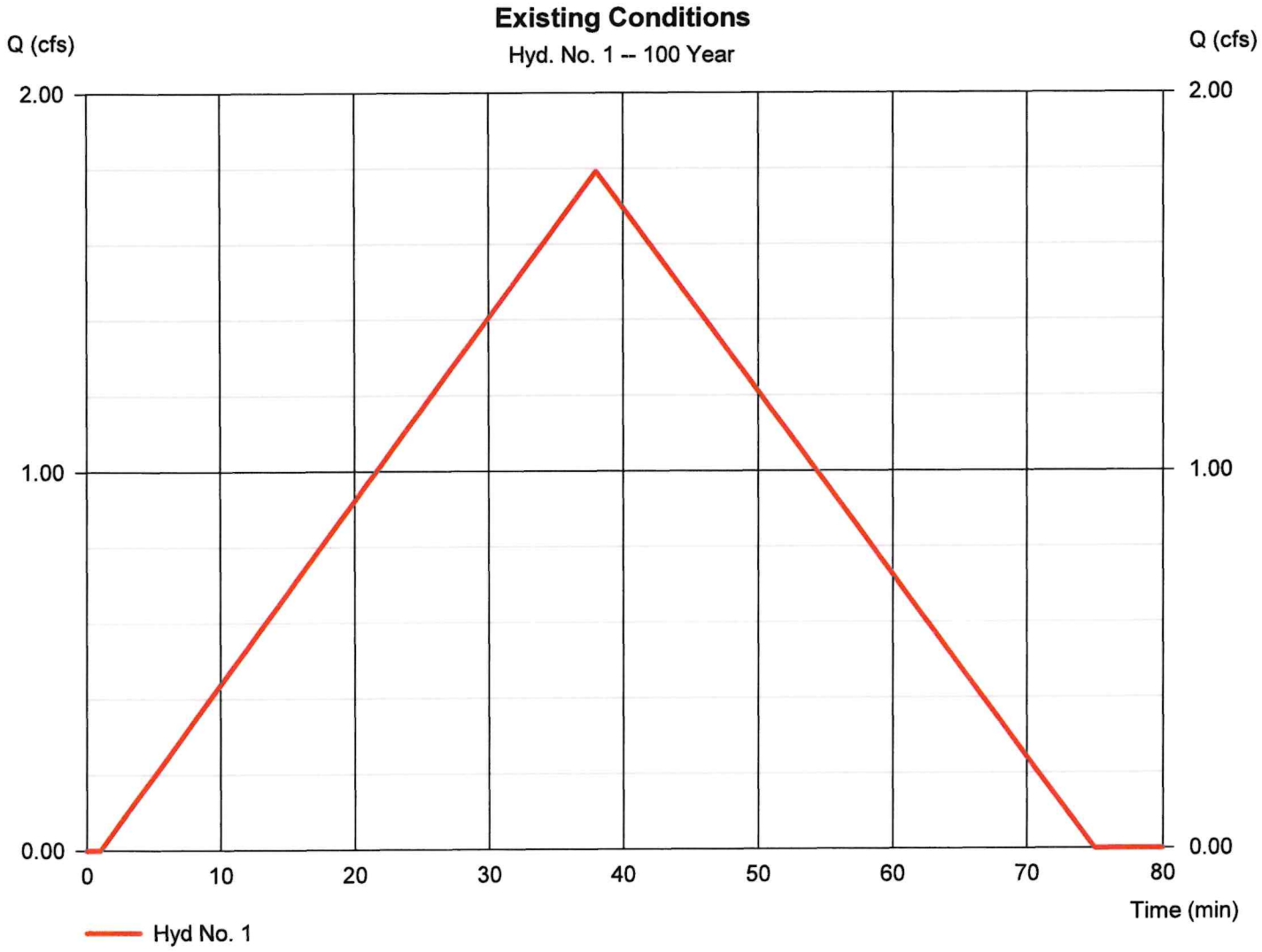
Hydrograph Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 — Wednesday, 09 / 9 / 2015

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 1.792 cfs
Storm frequency	= 100 yrs	Time to peak	= 38 min
Time interval	= 1 min	Hyd. volume	= 4,073 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.3
Intensity	= 3.535 in/hr	Tc by TR55	= 37.87 min
IDF Curve	= ODOT AREA A.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

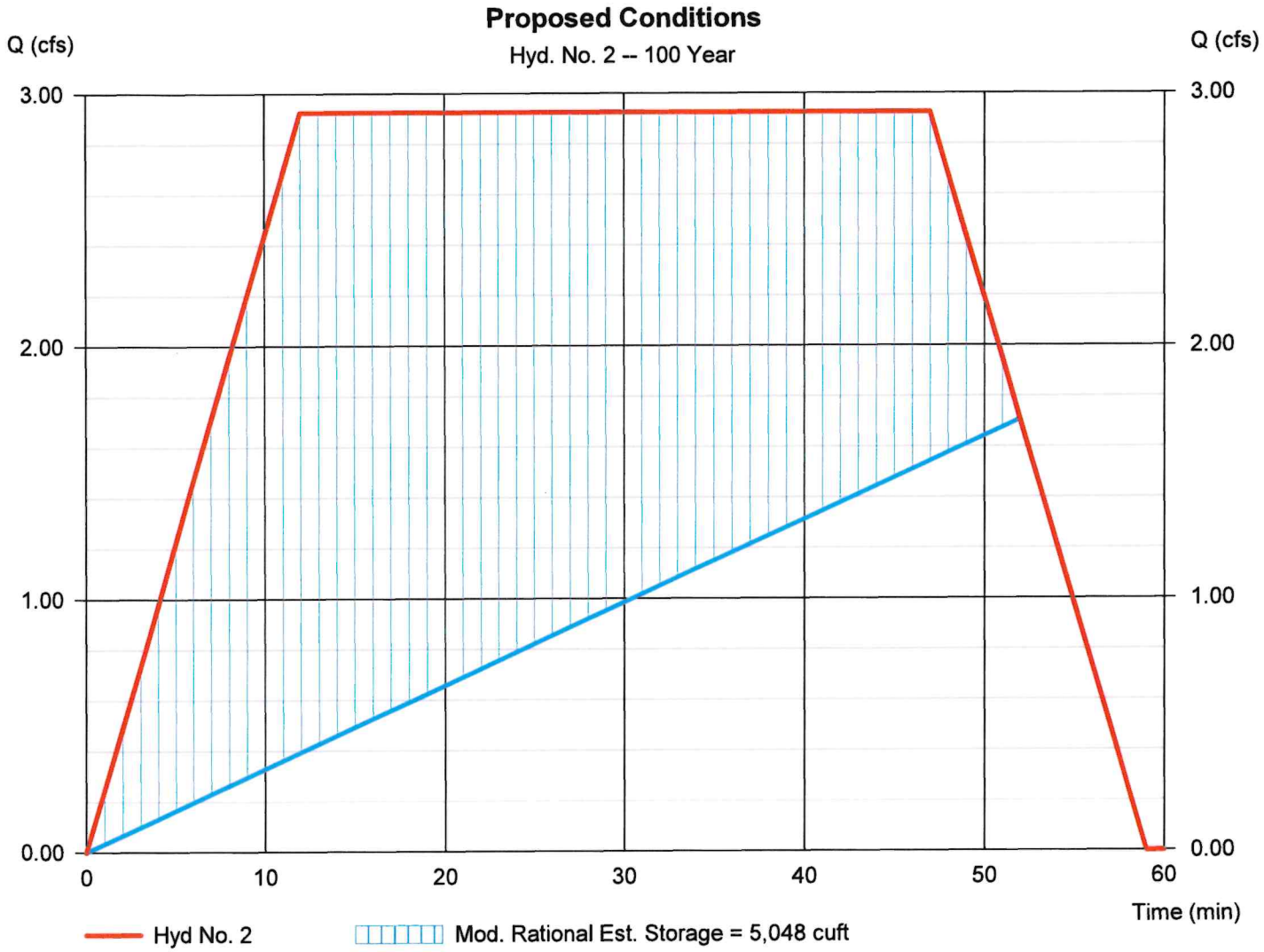
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 — Wednesday, 09 / 9 / 2015

Hyd. No. 2

Proposed Conditions

Hydrograph type	= Mod. Rational	Peak discharge	= 2.925 cfs
Storm frequency	= 100 yrs	Time to peak	= 12 min
Time interval	= 1 min	Hyd. volume	= 8,257 cuft
Drainage area	= 1.690 ac	Runoff coeff.	= 0.57*
Intensity	= 3.037 in/hr	Tc by User	= 12.00 min
IDF Curve	= ODOT AREA A.IDF	Storm duration	= 3.9 x Tc
Target Q	=1.790 cfs	Est. Req'd Storage	=5,048 cuft

* Composite (Area/C) = [(0.760 x 0.90) + (0.930 x 0.30)] / 1.690



Hydrograph Report

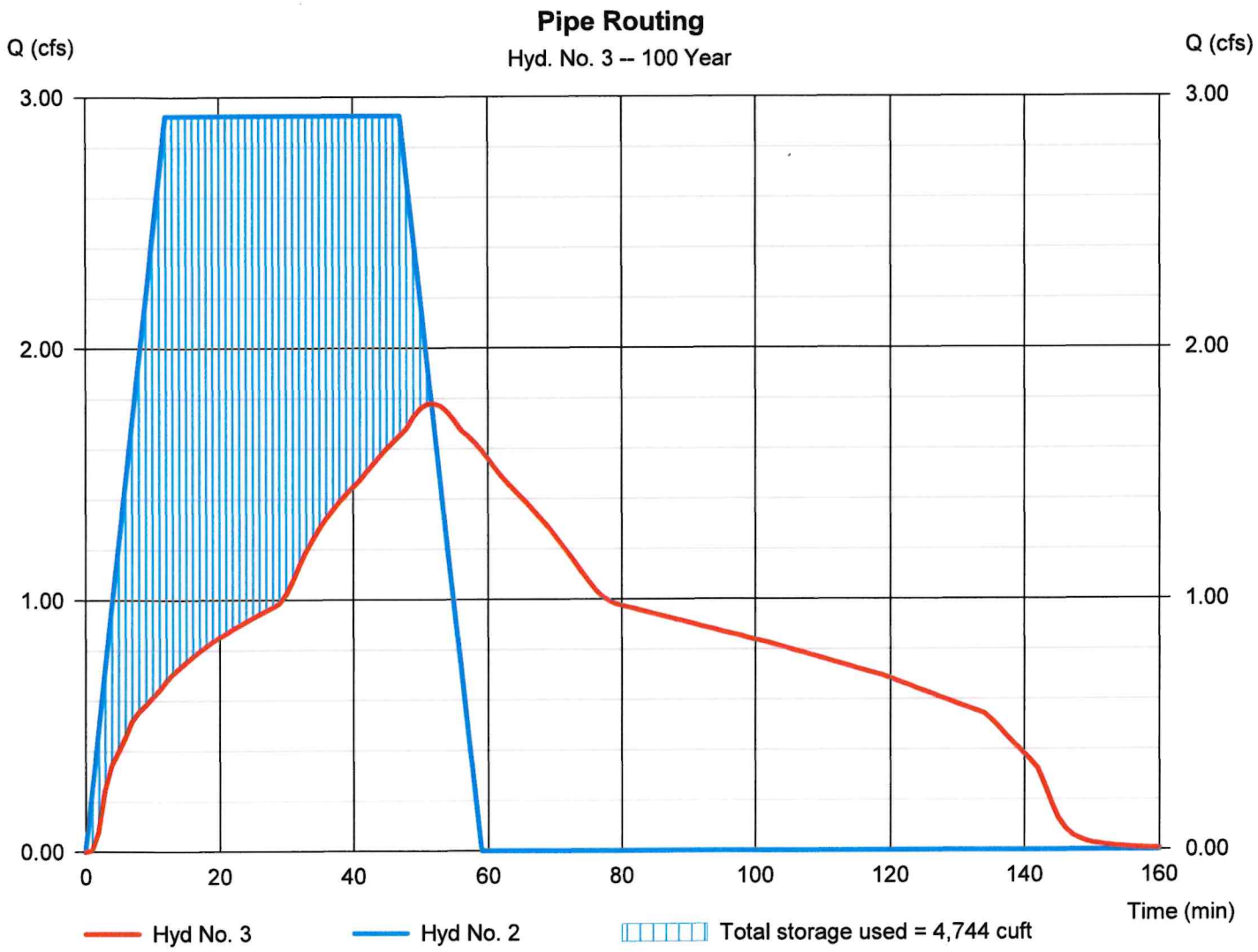
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2015 by Autodesk, Inc. v10.4 — Wednesday, 09 / 9 / 2015

Hyd. No. 3

Pipe Routing

Hydrograph type	= Reservoir	Peak discharge	= 1.779 cfs
Storm frequency	= 100 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 8,249 cuft
Inflow hyd. No.	= 2 - Proposed Conditions	Max. Elevation	= 929.90 ft
Reservoir name	= Oversized Pipe Storage	Max. Storage	= 4,744 cuft

Storage Indication method used.



RAINFALL REPORT

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	44.1500	8.9000	0.8530	--------
3	0.0000	0.0000	0.0000	--------
5	150.2710	18.4000	1.0620	--------
10	70.4740	10.2000	0.8740	--------
25	96.2800	11.1000	0.8990	--------
50	51.6220	5.1000	0.7470	--------
100	85.9300	8.0000	0.8340	--------

File name: ODOT AREA A.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	4.68	3.60	2.95	2.50	2.19	1.94	1.75	1.60	1.47	1.36	1.27	1.19
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	5.28	4.30	3.62	3.12	2.74	2.44	2.20	2.00	1.83	1.69	1.57	1.46
10	6.53	5.10	4.20	3.59	3.14	2.79	2.52	2.30	2.12	1.96	1.83	1.72
25	7.92	6.21	5.13	4.38	3.83	3.41	3.08	2.80	2.58	2.39	2.22	2.08
50	9.18	6.79	5.49	4.65	4.06	3.62	3.28	3.00	2.77	2.58	2.42	2.28
100	10.12	7.71	6.29	5.34	4.65	4.14	3.73	3.40	3.13	2.91	2.71	2.55

Tc = time in minutes. Values may exceed 60.

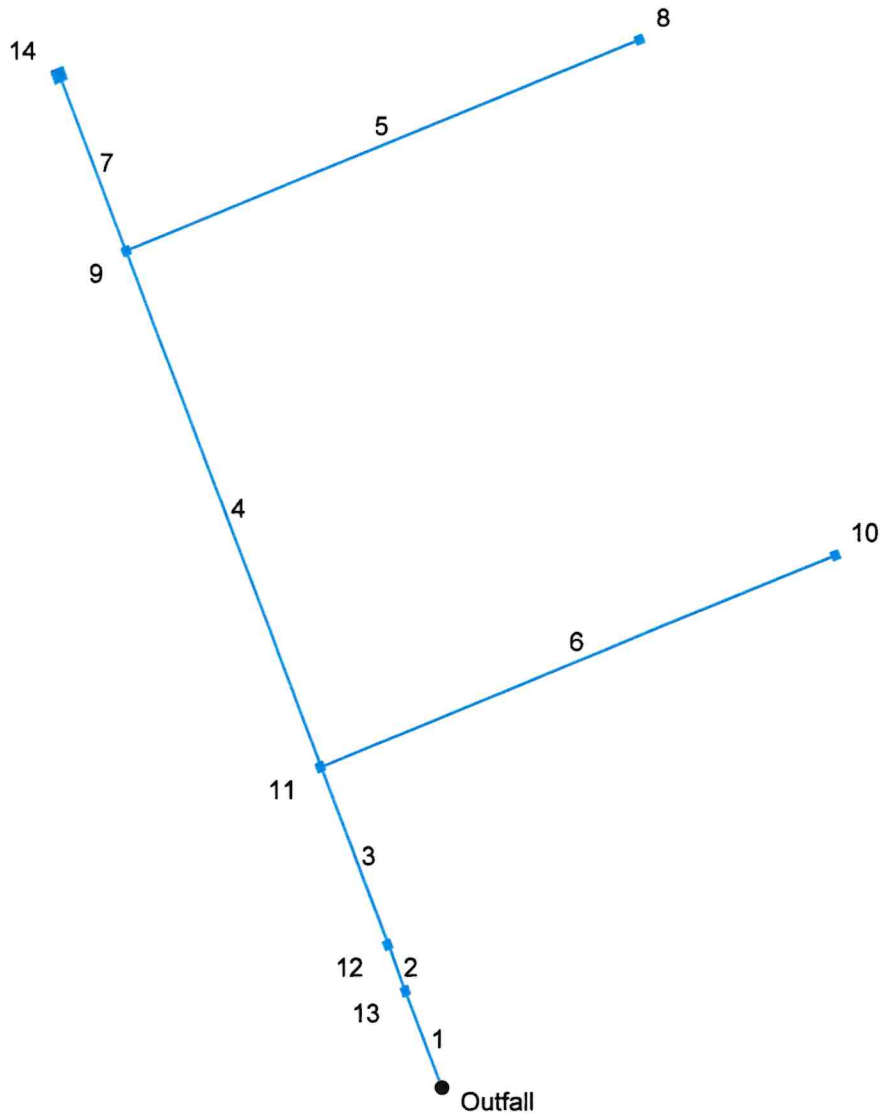
Precip. file name: U:\Computer Programs\Hydroflow Design\Akron Canton Airport 01-09-2013.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.10	2.43	0.00	3.03	3.54	4.29	4.94	5.65
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

STORM SEWER DESIGN CALCULATIONS

10 YEAR FREQUENCY STORM

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: 47190 Jimmy Johns Storm Sewer.stm	Number of lines: 7	Date: 9/2/2015

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	21.262	0.00	1.70	0.00	0.00	0.97	0.0	112.9	1.1	1.02	4.69	3.97	12	2.30	924.25	924.74	924.57	925.16	928.99	931.71	13 TO HW2
2	1	10.000	0.00	1.70	0.00	0.00	0.97	0.0	112.8	1.1	1.02	2.18	2.73	12	0.50	924.74	924.79	925.22	925.27	931.71	932.20	12 TO 13
3	2	39.005	0.25	1.70	0.90	0.23	0.97	10.0	110.8	1.1	1.04	86.89	1.58	48	0.49	924.79	924.98	925.29	925.32	932.20	931.85	11 TO 12
4	3	113.516	0.23	1.22	0.90	0.21	0.54	10.0	100.2	1.2	0.62	88.99	1.58	48	0.51	924.98	925.56	925.38	925.79	931.85	931.88	9 TO 11
5	4	118.500	0.06	0.06	0.90	0.05	0.05	10.0	10.0	5.1	0.28	87.85	1.39	48	0.50	925.56	926.15	925.79	926.30	931.88	932.35	8 TO 9
6	3	118.501	0.23	0.23	0.90	0.21	0.21	10.0	10.0	5.1	1.05	87.86	2.06	48	0.50	924.98	925.57	925.38	925.86	931.85	932.44	10 TO 11
7	4	38.692	0.93	0.93	0.30	0.28	0.28	15.0	15.0	4.2	1.17	2.22	2.87	12	0.52	925.56	925.76	926.08	926.28	931.88	931.00	14 TO 9

Project File: 47190 Jimmy Johns Storm Sewer.stm

Number of lines: 7

Run Date: 9/2/2015

NOTES:Intensity = 70.47 / (Inlet time + 10.20) ^ 0.87 ; Return period =Yrs. 10 ; c = cir e = ellip b = box

HYDRUALIC GRADE LINE CALCULATIONS

25 YEAR FREQUENCY STORM

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line	(ft)	Incr (ac)	Total (ac)	(C)	Incr	Total	Inlet (min)	Syst (min)	(in/hr)	(cfs)	(cfs)	(ft/s)	Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	21.262	0.00	1.70	0.00	0.00	0.97	0.0	94.4	1.5	1.42	4.69	4.40	12	2.30	924.25	924.74	924.63	925.24	928.99	931.71	13 TO HW2
2	1	10.000	0.00	1.70	0.00	0.00	0.97	0.0	94.4	1.5	1.42	2.18	2.96	12	0.50	924.74	924.79	925.33	925.38	931.71	932.20	12 TO 13
3	2	39.005	0.25	1.70	0.90	0.23	0.97	10.0	92.7	1.5	1.44	86.89	1.58	48	0.49	924.79	924.98	925.40	925.41	932.20	931.85	11 TO 12
4	3	113.516	0.23	1.22	0.90	0.21	0.54	10.0	84.0	1.6	0.87	88.99	1.69	48	0.51	924.98	925.56	925.47	925.83	931.85	931.88	9 TO 11
5	4	118.500	0.06	0.06	0.90	0.05	0.05	10.0	10.0	6.2	0.34	87.85	1.41	48	0.50	925.56	926.15	925.83	926.32	931.88	932.35	8 TO 9
6	3	118.501	0.23	0.23	0.90	0.21	0.21	10.0	10.0	6.2	1.29	87.86	2.06	48	0.50	924.98	925.57	925.47	925.90	931.85	932.44	10 TO 11
7	4	38.692	0.93	0.93	0.30	0.28	0.28	15.0	15.0	5.1	1.43	2.22	3.01	12	0.52	925.56	925.76	926.14	926.34	931.88	931.00	14 TO 9

Project File: 47190 Jimmy Johns Storm Sewer.stm | Number of lines: 7 | Run Date: 9/9/2015

NOTES:Intensity = 96.28 / (Inlet time + 11.10) ^ 0.90 ; Return period =Yrs. 25 ; c = cir e = ellip b = box

IDF VALUES

General Notes – Figures 1101-2 through 1101-3

The Rainfall Intensity-Duration-Frequency curves are based upon data obtained from United States Weather Service Technical Paper No. 40 Rainfall Frequency Atlas of The United States.

Federal Highway Administration Hydraulic Engineering Circular No. 12 Appendix A offers a methodology for converting I-D-F data points to an equation of the general form:

$$i = a/(t+b)^c$$

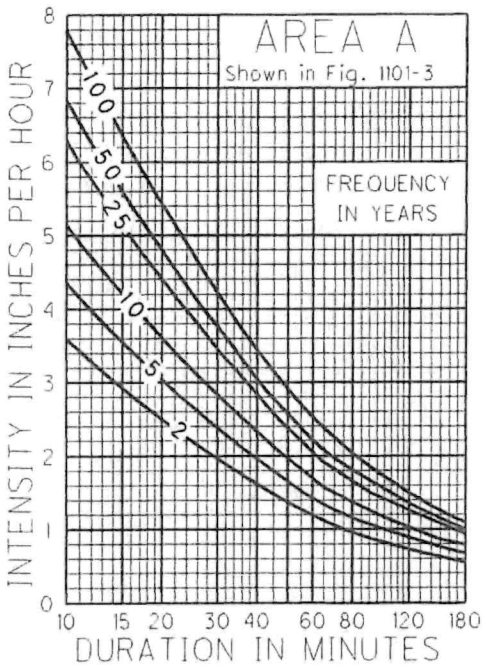
Where: i = rainfall intensity (inches/hour)
t = time of concentration (minutes)
a = constant
b = constant
c = constant

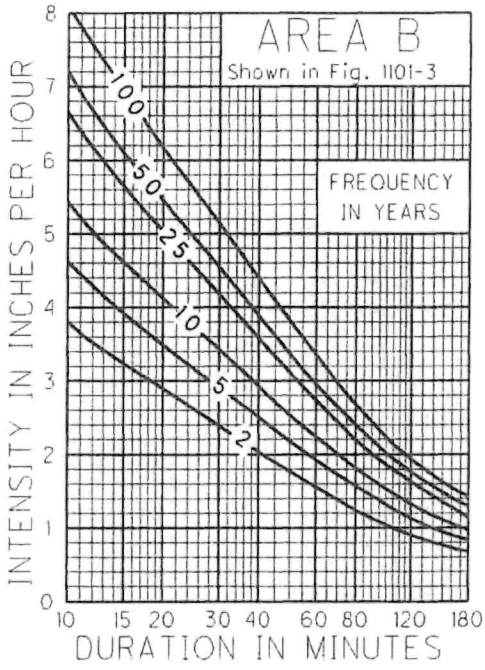
Using the above referenced methodology the curves in Figure 1101-2 can be expressed using the above general equation utilizing the constants shown below.

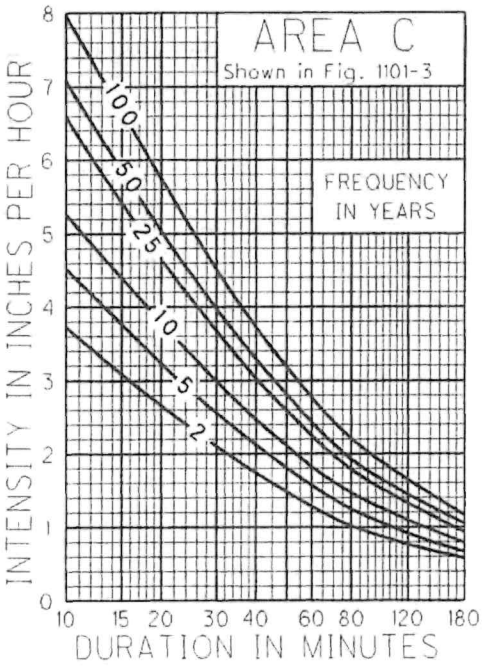
Intensity Zone (Figure 1101-3)	Frequency (Years)	Constant "a"	Constant "b"	Constant "c"
A	2	44.150	8.900	0.853
	5	150.271	18.400	1.062
	10	70.474	10.200	0.874
	25	96.280	11.100	0.899
	50	51.622	5.100	0.747
	100	85.930	8.000	0.834
B	2	140.596	25.099	1.015
	5	81.276	18.800	0.855
	10	275.649	29.499	1.070
	25	294.909	28.099	1.044
	50	117.148	16.700	0.849
	100	293.888	26.699	1.000
C	2	64.387	14.300	0.896
	5	184.940	21.699	1.075
	10	83.828	12.500	0.887
	25	58.733	7.400	0.771
	50	79.945	9.300	0.818
	100	196.039	16.300	0.978
D	2	85.568	16.500	0.950
	5	118.822	18.700	0.969
	10	112.172	16.800	0.923
	25	198.920	19.300	1.004
	50	206.025	19.600	0.990
	100	355.551	23.199	1.076

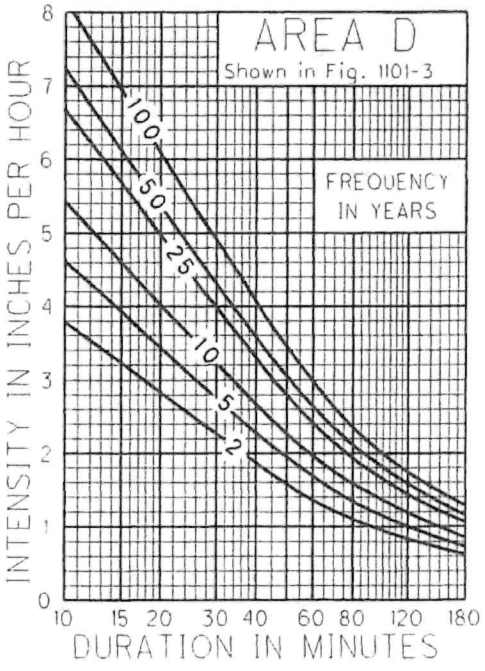
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.2.4

RAINFALL INTENSITY-FREQUENCY-DURATION CURVES









RAINFALL INTENSITY ZONE MAP

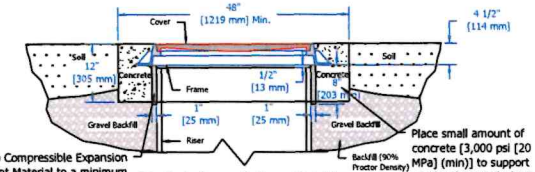
1101-3

REFERENCE SECTION
1101.2.4

STANDARD DETAILS

Aqua-Swirl Polymer Coated Steel (PCS)
Stormwater Treatment System

Unless other traffic barriers are present, bollards shall be placed around access riser(s) in non-traffic areas to prevent inadvertent loading by maintenance vehicles.

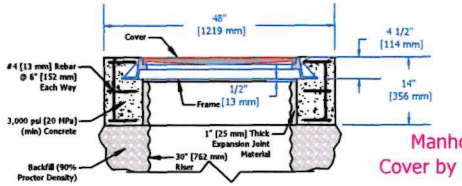


Wrap Compressible Expansion Joint Material to a minimum inch [25 mm] thickness around top of riser to allow transfer of inadvertent loading from manhole cover to concrete slab.

Manhole Frame & Cover Detail
For Non-Traffic Areas Only
NTS

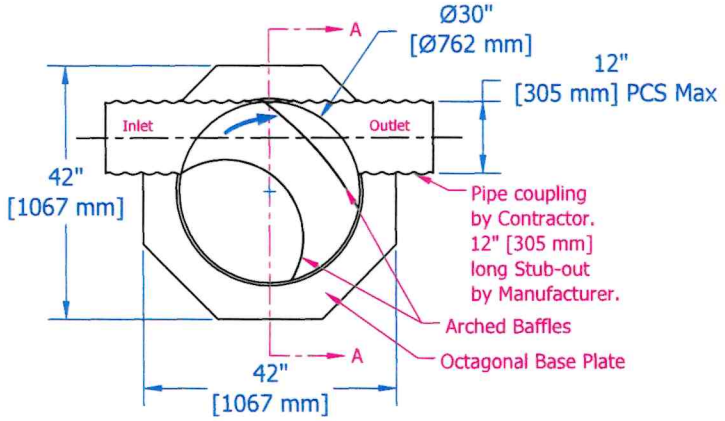
Place small amount of concrete [3,000 psi [20 MPa] (min)] to support and level manhole frame. DO NOT allow manhole frame to rest upon riser.

If traffic loading (H-20) is required or anticipated, a 4-foot [1.22 m] diameter, 14-inch [356 mm] thick reinforced concrete pad must be placed over the Stormwater Treatment System Riser to support and level the manhole frame, as shown. The top of riser pipe must be wrapped with compressible expansion joint material to a minimum 1-inch [25 mm] thickness to allow transfer of wheel loads from manhole cover to concrete slab. Manhole cover shall bear on concrete slab and not on riser pipe. The concrete slab shall have a minimum strength of 3,000 psi [20 MPa] and be reinforced with #4 [13 mm] reinforcing steel as shown. Minimum cover over reinforcing steel shall be 1-inch [25 mm]. Top of manhole cover and concrete slab shall be level with finish grade.

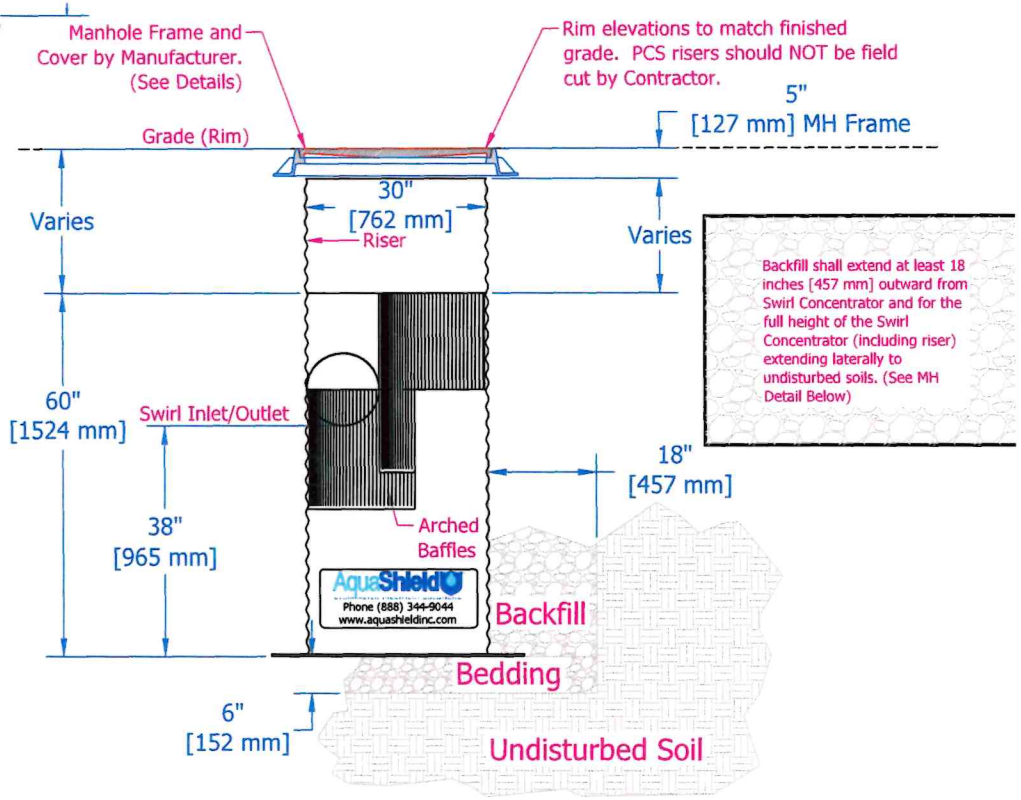


Manhole Frame & Cover Detail
For Traffic Loading Areas
NTS

*** Please see accompanied Aqua-Swirl specification notes.**
*** See Site Plan for actual system orientation.**



Plan View



Section A-A

AquaShield
STORMWATER TREATMENT SOLUTIONS
'05 Kanasita Drive, Chattanooga, TN 37343
Phone (888) 344-9044 Fax (423) 826-2112
www.aquashieldinc.com

Document:	AS-2 PCS STD
Drawn By:	JCW
Scale:	1:20
Date:	01/20/11

U.S. Patent No. 6524473 and other Patent Pending

Aqua-Swirl Concentrator Model AS-2 CFD PCS Standard Detail

AQUA-SWIRL™ PCS SPECIFICATION NOTES

03-19-13

1. Manufacturer shall be responsible for complete assembly of Swirl Concentrator.

2. Polymer Coated Steel (PCS) Swirl Concentrator shall be fabricated from polymer pre-coated steel sheet for corrugated steel pipe, and shall comply with ASTM A 760 and ASTM A 742.

3. Stub outs and internal components shall be supplied by manufacturer and MIG welded using accepted welding practices.

4. Manufacturer shall supply direct access to Swirl Concentrator via 30-inch ID riser(s). Riser should not be field cut by Contractor, Riser should maintain its finish cut length as supplied by manufacturer to match final grade per approved site elevations (as indicated on approved shop drawing). If necessary to extend riser, Contractor should use adjusting rings to bring top of structure to grade.

5. Contractor shall supply pipe couplings to and from Swirl Concentrator, which shall be Mar-Mac, Fernco, or Mission style flexible boot with stainless steel tension bands and shear guard. Mar-Mac couplings should be used for connections to corrugated plastic pipe and are recommended for use with larger diameter pipe (e.g. 24" ID and larger). A concrete cradle is recommended beneath Mar Mac's to prevent joint movement.

6. Contractor shall prepare excavation and off-load Swirl Concentrator. Contractor is responsible for bedding and backfill around Swirl Concentrator as detailed on site plan. (see notes 11 and 12)

7. Manufacturer shall supply standard manhole frame(s) and cover(s). (Traffic rated H20)

8. Where traffic loading (H-20) is required or anticipated, a 4-foot diameter, 14-inch thick reinforced concrete pad must be placed over the Swirl Concentrator to support and level the manhole frame. The top of riser pipe must be wrapped with compressible expansion joint material to a minimum 1-inch thickness to allow transfer of wheel loads from manhole cover to concrete slab. Manhole cover shall bear on concrete slab and not on riser pipe. The concrete slab shall have a minimum strength of 3,000 psi and be reinforced with #4 reinforcing steel (per drawing). Minimum cover over reinforcing steel shall be 1-inch. Top of manhole cover and concrete slab shall be level with finish grade.

9. Unless other traffic barriers are present, bollards shall be placed around access risers in non-traffic areas to prevent inadvertent loading by maintenance vehicles. Sample of typical bollard installation detail and recommended locations of bollards around the Swirl Concentrator can be provided upon request.

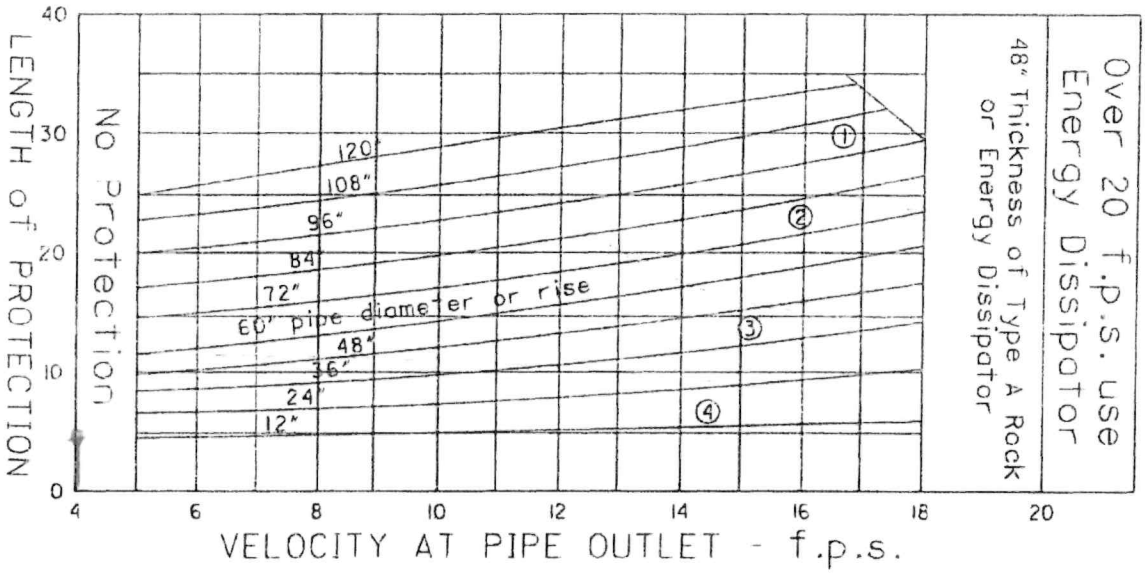
10. Where high groundwater elevations are present or anticipated, Contractor shall supply concrete anti-floatation pad underneath and poured over the octagonal base plate of the swirl (see Anti-Floatation Base Detail) to prevent buoyancy and base plate deflection (details, if necessary, available upon request).

11. Excavation and Bedding - The trench and trench bottom shall be constructed in accordance with ASTM A 798 Section 5, Trench Excavation, Section 6, Foundation, and Section 7, Bedding. The PCS Swirl Concentrator shall be installed on a stable base consisting of at least 6-inches of fine, readily compacted soil or granular fill material, and compacted to 95% proctor density. Bedding shall not contain stones retained on a 3-inch ring, frozen lumps, highly plastic clay, organic material, corrosive material, or other deleterious foreign materials. All required safety precautions for Swirl Concentrator installation are the responsibility of the Contractor and shall be per OSHA approved methods.

12. Backfill Requirements - Backfill materials shall be fine, readily compacted soil or granular fill material, and compacted to 90% proctor density. Processed granular materials with excellent structural characteristics are preferred. Coarse grained soils of USCS Groups GW, GP, GM, GC, SW, and SP as described in ASTM D 2487 are generally acceptable materials when compacted to 90% proctor density. Backfill shall not contain stones retained on a 3-inch ring, frozen lumps, highly plastic clay, organic material, corrosive material, or other deleterious foreign materials. Backfilling shall conform to ASTM A 798, Section 10, Structural Backfill Placement. Backfill shall be placed in 6 to 12 inch layers or "lifts" and compacted before adding the next lift. Backfill shall extend at least 18 inches outward from Swirl Concentrator and for the full height of the Swirl Concentrator (including riser(s)) extending laterally to undisturbed soils.

ROCK OUTLET PROTECTION

SIZING CALCULATIONS



NOTES

Rock size (6", 12", 18") indicates the square opening on which 85% of the material, by weight, will be retained.

The width of protection shall be the width of the headwall, with 4' being the minimum.

(Where a stream bed will withstand the calculated velocity without erosion, no rock channel protection will be required.)

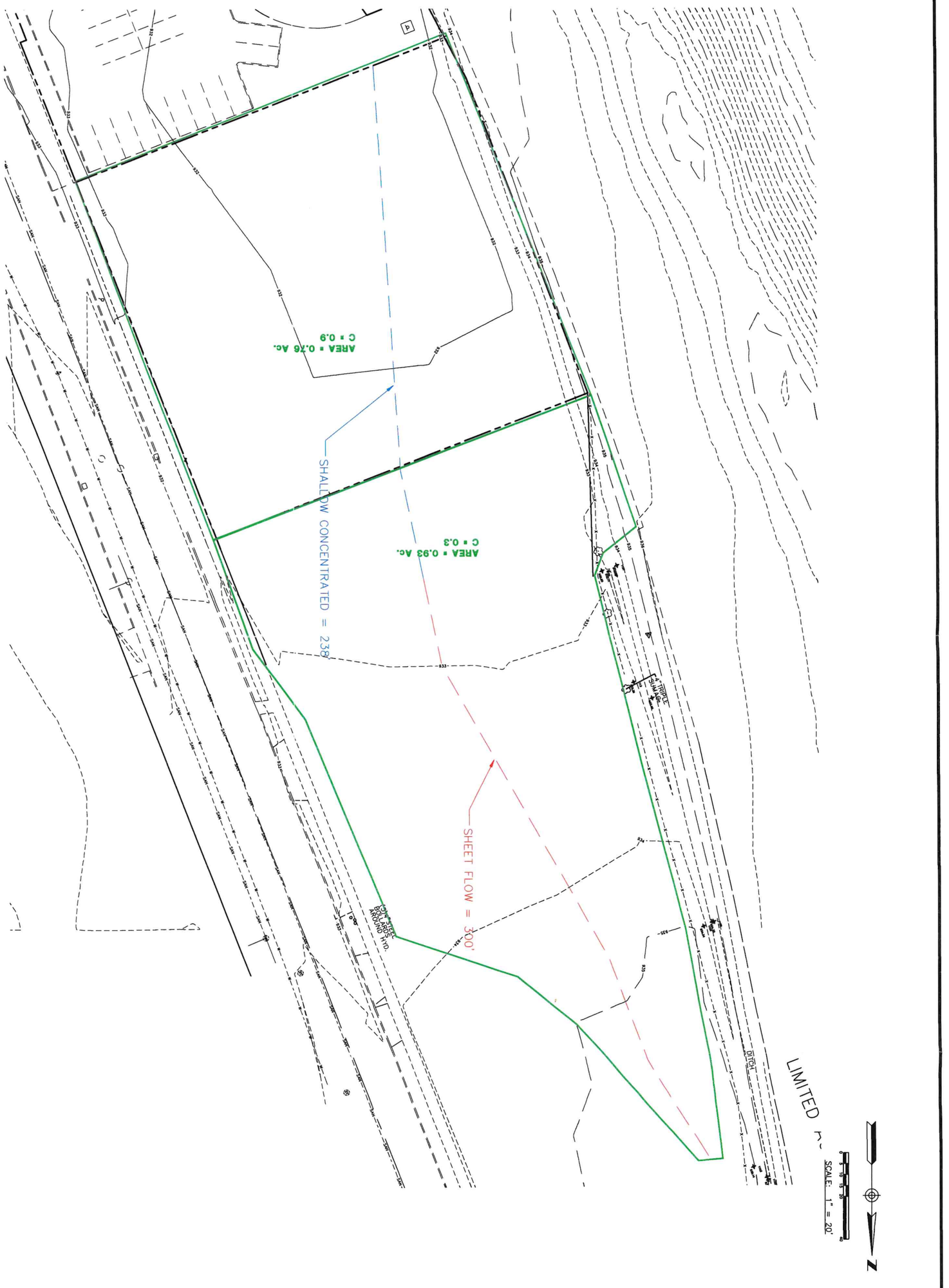
LEGEND	ROCK TYPE
①48" of 18" rock	A
②36" of 18" rock	A
③30" of 12" rock	B
④18" of 6" rock	C

Source: ODOT Location and Design Manual, Rock Channel Protection at Culvert and Storm Sewer Outlets

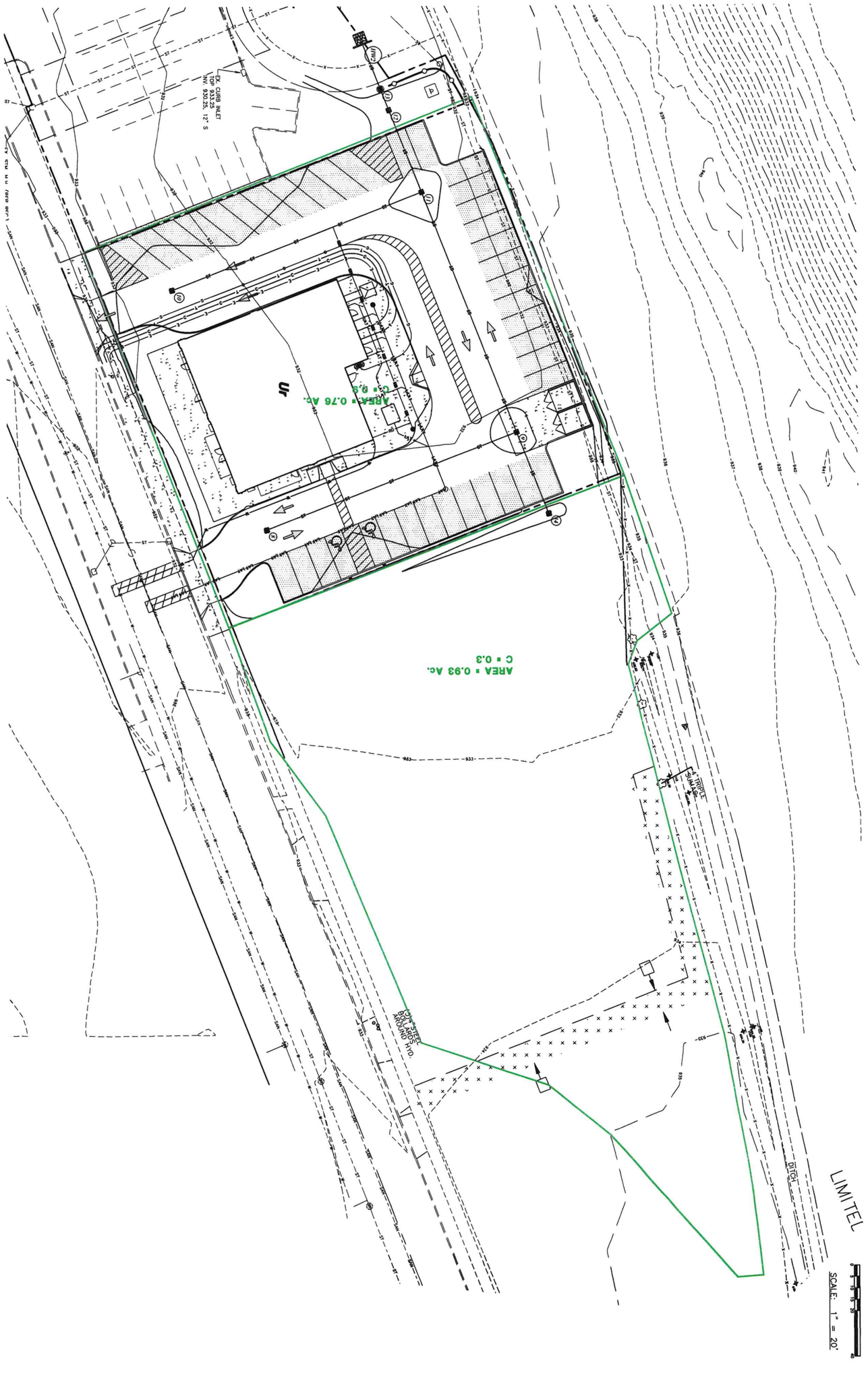
Figure 4.4.1 Length of Rock Outlet Protection and Rock Size

- VELOCITY AT PIPE OUTLET = 3.97 F/S (SEE STORM SEWER CALCULATIONS)
- OUTLET PIPE DIAMETER = 12 INCHES
- ACCORDING TO ABOVE CHART NO PROTECTION IS REQUIRED
- PROPOSED 5'-0" x 5'-0" x 1.5' TYPE 'C' OUTLET PROTECTION IS SHOWN TO BE CONSERVATIVE

DRAINAGE MAPS



DEVILLE 21 LINCOLN WAY OUTLOT 17416 MASSILLON, OHIO EXISTING CONDITIONS DRAINAGE MAP	21 LINCOLN WAY PROJECT LLC SUITE 301 3951 CONVENIENCE CIRCLE N.W. CANTON, OH 44718	GBC DESIGN, INC. 565 White Pond Dr. Akron, OH 44320 Phone 330-536-0225 Fax 330-536-5782	DRAWN BY: T.G.W.	DATE: 6/26/2015	PROJECT NO. 471908	DRAWING NO. 1 OF 2	REVISIONS



DEVILLE 21 LINCOLN WAY
OUTLOT 17416
MASSILLON, OHIO
PROPOSED CONDITIONS DRAINAGE MAP

21 LINCOLN WAY PROJECT LLC
SUITE 301
3951 CONVENIENCE CIRCLE N.W.
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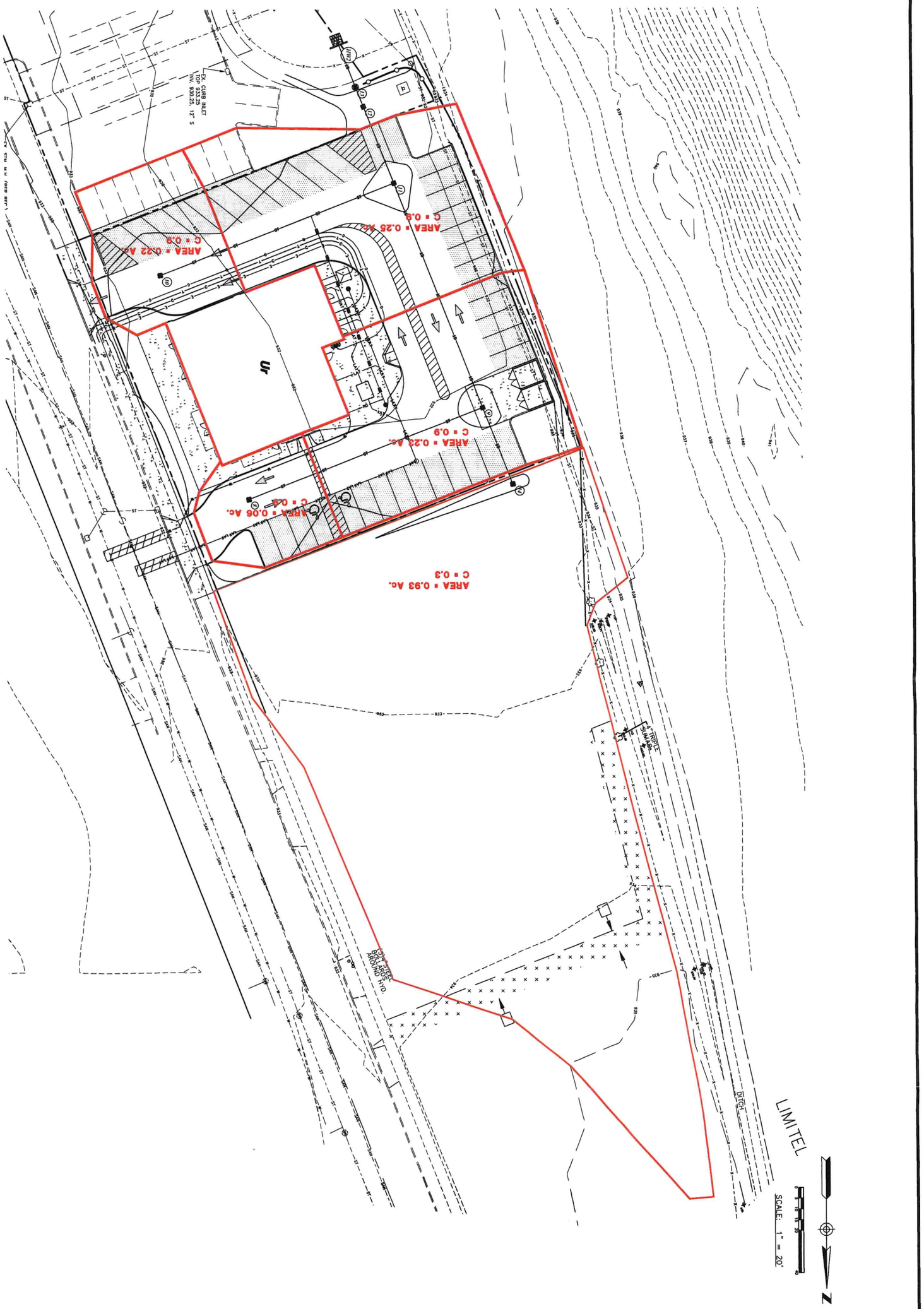
DRAWN BY: T.G.W.
DATE: 6/26/2015
PROJECT NO. 471909
DRAWING NO. 2 OF 2
REVISIONS



DEVILLE 21 LINCOLN WAY OUTLOT 17416 MASSILLON, OHIO STORM INLET DRAINAGE MAP	21 LINCOLN WAY PROJECT LLC SUITE 301 3951 CONVENIENCE CIRCLE N.W. CANTON, OH 44718	GBC DESIGN, INC. 565 White Pond Dr. Akron, OH 44320 Phone 330-836-0228 Fax 330-836-5782	DRAWN BY: T.G.M. DATE: 6/26/2015 PROJECT NO. 471908 DRAWING NO. 1 OF 1	REVISIONS